# PROCEEDINGS

OF THE

# ROYAL SOCIETY OF EDINBURGH.

VOL. VII. 1870–71. No. 82.

## Eighty-Eighth Session.

*Monday, 28th November* 1870.

Dr CHRISTISON, President, in the Chair.

The following Council were elected :—

*President.*
Professor CHRISTISON, M.D., D.C.L.

*Honorary Vice-President.*
His Grace the DUKE of ARGYLL.

*Vice-Presidents.*

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| David Milne Home, LL.D. | Professor Sir William Thomson. |
| Professor Kelland. | William Forbes Skene, LL.D. |
| The Hon. Lord Neaves. | Principal Sir Alex. Grant, Bart. |

*General Secretary*—Dr John Hutton Balfour.

*Secretaries to the Ordinary Meetings.*
Professor Tait.
Professor Turner.

*Treasurer*—David Smith, Esq.
*Curator of Library and Museum*—Dr Maclagan.

*Councillors*

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| Dr James M'Bain, R.N. | Rev. Dr W. Lindsay Alexander. |
| Dr William Robertson. | Professor Fleeming Jenkin. |
| Thomas Stevenson, Esq., C.E. | Prof. Wyville Thomson, LL.D. |
| Dr Handyside. | James Donaldson, LL.D. |
| Archibald Geikie, Esq. | Dr Thomas R. Fraser. |
| Professor A. Crum Brown. | Dr Arthur Gamgee. |

*Monday, 5th December* 1870.

David Milne Home, Esq., Vice-President, read the following Address:—

GENTLEMEN, FELLOWS OF THE ROYAL SOCIETY OF EDINBURGH,—In compliance with a special request of the Council, I come before you this evening to deliver the Address usually given at the opening of our Winter Session.

This practice of annually taking stock to ascertain what business we are doing, and how we are doing it, seems to me very right and expedient. The whole Society is thus made aware whether it is retrograding or advancing,—whether it is or is not, carrying out the objects of its institution.

I see that in some former Addresses, not only was the existing state of the Society reported on, but occasion was taken to open up general views on science and literature, and sometimes to point out important discoveries recently made in particular fields of knowledge. An Address of that instructive character probably would have been given to-night, had the place I now unworthily hold, been occupied by the distinguished *savant* who stood above me on the roll of Vice-Presidents, as he also stands immeasurably above me in knowledge. That gentleman's numerous engagements elsewhere, and the expectation that he would be in Italy, prevented his guaranteeing to the Council when they applied to him, that he would be here to-night. My own usual avocations are not such as fit me for executing the duty which Dr Lyon Playfair would have so ably performed,—my time being chiefly occupied with the duties incumbent on a landed proprietor resident in the country, who has to attend justice of peace courts, road meetings, cattle plague committees, and parochial boards. My address, therefore, will not be literary or scientific, but of a practical character as more congenial to my habits of life;—containing nevertheless some information and suggestions which I hope may not be entirely useless.

What I shall venture to submit, will be under the following heads:—

1*st*. The work done by us as a Society, during the past year.
2*d*. The means we possess, of doing our work.
3*d*. Suggestions for rendering our Society more efficient.
4*th*. The usefulness of Societies like ours.
5*th*. The best way of encouraging and assisting such Societies.

### I. *Work of the Society during the past Year.*

The ordinary business of the Society, as we all know, is done during the winter, at evening meetings, when papers are read. These are abstracted into our printed Proceedings, and the most valuable inserted *verbatim* in our Transactions.

The number of our meetings last winter was 13, being on an average two, each month. The number of papers read at these meetings, was 43. The authors of these, were 33 persons.

Of the 43 papers, 5 were literary; the other 38 papers, on matters of physical science.

In the previous year, the total number of papers had been 44, *all* on physical subjects.

The following epitome shows the number of the papers under each branch of science:—

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| Mathematical papers, . . . . | 11 |
| Chemical „ . . . . | 7 |
| Mechanical or Natural Philosophy papers, . | 6 |
| Medical . . . . „ . | 4 |
| Geological . . . . „ . | 3 |
| Zoological . . . . „ . | 3 |
| Geographical . . . . „ | 2 |
| Botanical . . . . „ . | 1 |
| Meteorological . . . „ . | 1 |

In a few instances, and I regret they were so few, discussion occurred on the part of the Fellows present, after the papers were read or described.

I have said that all these papers appear in an abstracted form in our printed Proceedings. Last year's printed Proceedings extend to 209 octavo pages. Those of the year before, contained 200 pages.

Of the 43 papers presented last winter, 11 were selected as worth

of publication in our Transactions. The titles and authors of these papers were as follows :—

1. Reciprocal Figures, Frames, and Diagrams of Forces. By J. Clerk Maxwell, F.R.S.
2. Scientific Method in the Interpretation of Popular Myths, with Special Reference to Greek Mythology. By Professor Blackie.
3. Extension of Brouncker's Method to the Comparison of Several Magnitudes. By Edward Sang, Esq.
4. Green's and other Allied Theorems. By Professor Tait.
5. Heat developed in the Combination of Acids and Bases. By Dr Thos. Andrews, Hon. F.R.S.E.
6. The Genetic Succession of Zooids in the Hydroida. By Prof. Allman.
7. Influence of the Vagus upon the Vascular System. By Prof. Rutherford, of King's College, London.
8. Old River Terraces of the Earn and Teith, viewed in connection with certain proofs of the Antiquity of Man. By Rev. Thos. Brown.
9. Spectra formed by the Passage of Polarised Light through Double Refracting Crystals. By Francis Deas, LL.B.
10. Oxidation Products of Picoline. By James Dewar, Esq.
11. Account of the Great Finner Whale stranded at Longniddry. By Professor Turner.

I may here add that our volumes of Transactions are rapidly exhibiting an increase in the number,—I hope also in the value of their contents. About ten or twelve years ago, one year's Transactions did not exceed 100 quarto pages. During the three years which followed, their average size was measured by 250 pages; during the last three years by 310 pages.

The Society is aware that we have three prizes in our gift, created by members of our body at different periods,—the Neill prize, the Keith prize, and the Brisbane prize. A period of two years elapses, in the case of the two latter, before bestowal. Last year the Keith prize was awarded, consisting of a gold medal and £50, "for the best communication on a scientific subject." It was awarded to Professor Tait, for a paper, published in our Transactions, on the "Rotation of a Rigid Body about a fixed point."

In alluding to the award of this prize, it is only right to mention the high estimation in which, as I have reason to know, this paper and other mathematical papers by the same author are held by men of science. These papers are examples of the application and use of a new and wonderful instrument of analysis invented by the late Sir William Hamilton of Dublin, one of the profoundest philosophers of his day, known by the name of "*Quaternions.*" I am told that there are as yet few mathematicians who can work with it. But Professor Tait has been able, both to work with it, and to improve upon it; and has applied it to the solution of many important physical questions not easily solved by ordinary analysis.

To show that these remarks rest on better testimony than my own, I beg to refer to the high appreciation of Professor Tait's application of "Quaternions," as expressed by the distinguished inventor himself, in a work published shortly after his death. Sir William Hamilton's "Elements of Quaternions" (page 755) contains the following passage :—

"Professor Tait, who has already published tracts on other applications of Quaternions, mathematical and physical, including some on Electro-dynamics, appears to the writer eminently fitted to carry on, happily and usefully, this new branch of mathematical science, and likely to become in it, if the expression may be allowed, one of the chief successors to its inventor."

To these gracious words of Hamilton, may be added the testimony of Professor Sir William Thomson of Glasgow, himself a mathematician and physicist second to none in Europe, contained in a letter to our General Secretary, from which I am allowed to quote :—

"My Dear Balfour,—The marked appreciation by Sir William Hamilton of Tait's work in quaternions, is about the highest possible testimonial to its excellence. His book on the subject will constitute, I believe, a permanent monument of the most marvellously ingenious generalisation ever made in mathematical science. It has already done much to render the new instrument available for researches in Natural Philosophy, and I can see signs (witness the two most transcendent and practical naturalists of the age, Helmholtz and Clerk Maxwell) of quaternions becoming, through its teaching, a useful implement, though many years may pass before fruits resulting from quaternionic husbandry can be gathered."

Besides the ordinary business of the Society for the past year

to which I have been adverting, there have been one or two other matters taken up by the Council which it is proper to mention—

(1.) The Council agreed to co-operate with other public bodies in this town, in giving to the British Association for the Advancement of Science, an invitation to hold their next year's meeting in Edinburgh. That invitation was communicated through our general secretary, Professor Balfour, at the Liverpool meeting. We all know the result; but perhaps all do not know how much is due to the efforts of this Society. It must also be matter of congratulation to ourselves to learn, that the President elect of the Association is one of our own members—a member of whom any Society may feel proud—Sir William Thomson of Glasgow; and, moreover, that the local secretaries and treasurer of the meeting are all Fellows of our Society. May I therefore be allowed to express a hope, that the members of this Society will do their utmost to assist in promoting the success of the meeting, and that the Society will be able to give a handsome subscription to the fund for expenses.

(2.) Another matter out of the ordinary business of the Society, is the application which the Council made to Her Majesty's Government, for the establishment of a Chair of Geology in the University of Edinburgh, and for assistance to endow it.

The circumstance which led to this application was the resignation of Professor Allman, and an intimation received about the same time, from that eminent geologist and true-hearted Scotchman, Sir Roderick Impey Murchison, that he was willing to set apart £6000 from his own funds, to yield a moiety of the endowment.

The Council of the Society, feeling that they would go with greater hope of success to Government if backed by other public bodies, obtained the co-operation of the University, the Royal Scottish Society of Arts, the Geological Society, and the Highland and Agricultural Society.

We all know, in consequence of an intimation in the newspapers, that the Premier has so far yielded to these applications, by agreeing that Government should pay £200 yearly to this object; so that, adding the dividends which will be obtained from Sir Roderick Murchison's more generous gift of £6000, there will be

for the support of the chair, a fixed income of £450. I believe there is in existence a separate yearly sum of £35, hitherto drawn by the Professor of Natural History, and which, in the event of a separate Professorship being established for geology and mineralogy, was appointed to be transferred to the latter. This bequest was made a number of years ago by a Scottish gentleman named Thomson, who died at Palermo.

Before taking leave of this subject, I wish to draw attention to the fact that in the other Universities of Scotland the same inconvenience exists, which is about to be remedied in Edinburgh; and perhaps I may be permitted to express from this chair a hope, that in them also, means may be found for removing that inconvenience. I was glad to observe, that the Lord Rector of Aberdeen University, in an address delivered by him about ten days ago, took notice of the multifarious branches of instruction which the Professor of Natural History has there to teach, and is unable to overtake. Mr Grant Duff is a member of the present Government, so that I trust he will call the Premier's attention to the subject. The chair of Natural History at Aberdeen was established by the Crown, and its occupant is appointed by the Crown. I presume the design and intention of the Crown was, that geology, and the other recognised branches of Natural History, should be taught in that University. Therefore if, in consequence of the extension and growth of these branches, it has become impossible for any one man to give instruction in all, there seems to be a sort of moral obligation on the Crown to carry out its own intention and undertaking, by appointing separate Professors for these branches.

These remarks apply equally to the two other Universities of Glasgow and St Andrews; the latter, however, viz., St Andrews, presenting an additional evil of its own, viz., the anomaly, that the Professor of *Natural* History has to lecture on *Civil* History besides.

It humbly appears to me that there should be no great difficulty, both at St Andrews and at Glasgow, of providing means for remedying the evils to which I have been adverting. The Government gives aid to schools to an equal extent with funds supplied locally for their support, even when these schools are of an elementary character, and supply instruction only for a parish. Much more must Government be disposed to assist when

the institution wanting help, draws scholars from a wide area of country, as is the case with a University. What persons are so interested in establishing means of instruction in geology and mining, as proprietors of coal, iron, shale, fire-clay, and building stones? or who more able than they, to provide the amount of funds necessary to warrant an application to Government to assist in endowing professorships for giving that instruction. The counties of Fife and Forfar, near St Andrews;—the counties of Lanark, Renfrew, and Ayr, so intimately connected with Glasgow, are all rich in mines and minerals. Surely the proprietors and manufacturers of both districts will have patriotism enough to raise, by a conjoint effort, the sum which one single individual—their own countryman—though not resident among us, has so cheerfully given.

I have adverted to this subject so fully, because of the interest which our Society, from a very early period, has taken in this particular science. Indeed, it is to geology that our Society is chiefly indebted for the reputation it first acquired in the scientific world, in consequence of the animated and stirring speculations and discussions instituted by its members, among whom were Sir James Hall, Lord Webb Seymour, Col. Imrie, Hutton, Playfair, and Jameson. I believe that little or nothing was known of geology, in Great Britain, before the time to which I have alluded; and that even the Geological Society of London, founded in the year 1808, owed its origin chiefly to Scotsmen resident in England, who had imbibed their taste for the science by taking part in the discussions, or studying the transactions of our Society. When, from various causes, the science of geology at a later period begun to flag in Scotland, our Society lamented and remonstrated, and endeavoured to waken public sympathy on the subject. Thus the late Principal Forbes, in his address from this chair in the year 1862, says:—

"Of all the changes which have befallen Scottish science during the last half century, that which I most deeply deplore, is the progressive decay of our once illustrious geological school."

In the year 1865, our Society presented a memorial to the Government of which Earl Russell was then head, pointing out the inconvenience of there being no separate Professorship of Geology, and asking Government to institute one.

Though our attempt to obtain redress was not then successful, it may be presumed that good was done, by our having kept it before the eye of the public; and that seeds then were sown, which have now produced the results we had so long been desiring.

II. I come now to the next division of this address, which refers to

*The means we possess of carrying out the objects of the Society.*

I allude to strength of membership, and to available funds.

With regard to funds, I am happy to say that, though not rich, we have now rather more funds, than we have ever had before; thanks to our excellent treasurer, Mr Smith, who does what he can to keep up income, and keep down unnecessary expenditure.

Our income is derived from three main sources:—

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| (1.) Contributions of ordinary Fellows, about . | £800 |
| (2.) Dividends from capital invested, . . | 280 |
| (3.) Annual grant from Government, . . | 300 |
| Making a total revenue of | £1380 |

Our expenditure may be classed under the following five heads:—

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| (1.) Cost of printing and circulating Proceedings and Transactions, about . . . | £400 |
| (2.) Rent of apartments, taxes, cleaning, &c., . | 300 |
| (3.) Books, periodicals, and newspapers, . . | 150 |
| (4.) Salaries of officers, . . . . | 240 |
| (5.) Expenses of evening meetings, . . | 30 |
| | £1120 |

With regard to membership—the number of ordinary Fellows—on whom of course we chiefly depend for papers, and for attendance at our evening meetings, stands thus. This time last year, the total number was 303. Since then, 30 new ordinary members have been elected—making altogether 333. But from this number must be deducted five who have died, and two

who have resigned—leaving a balance at this date of 326; which is a larger number of ordinary Fellows than we have had since the institution of the Society. The number of our honorary members is the same as formerly, 36 foreigners, and 20 British—all men of known celebrity.

Before referring more particularly to the individual members who, during the past year, have been taken from us by death, allow me to say that I think the giving of obituary sketches of deceased associates is a practice highly becoming. It should be remembered that our Society is intended, not only to aid science and literature, but also to promote good fellowship among the votaries of both. One object of our association, is to encourage and assist one another by sympathy, and interchange of views; for which purpose we not only listen to papers, and discuss these at our evening meetings, but also hold personal intercourse in our library and reading-room. When, therefore, any of our comrades are removed from our midst by death, it is but fitting we should offer a parting tribute of regret at the dissolution of our connection, and endeavour to fix some traces of our departed associates in our memory, by recounting the part they have taken in helping to carry on the business of the Society, by recording any services rendered to the country, and by noting the leading events of their lives.

Whilst we have reason to be thankful that, during the past year, the number of deceased associates is small—smaller, when regard is had to the total number of members, than in any former year, that circumstance is more than counterbalanced by the worth and preciousness of the lives whose loss we deplore.

The following are the names of deceased Fellows, of each of whom I proceed to give a short obituary notice:—

ADAM HUNTER.
EDWARD FRANCIS MAITLAND.
ROBERT NASMYTH.
JAMES YOUNG SIMPSON.
JAMES SYME.

ADAM HUNTER was born at Greenock on 20th June, 1791. He obtained his classical and mathematical education at Glasgow

University, and afterwards came to Edinburgh for the medical classes. He graduated in the year 1813. He died in Edinburgh, 24th June, 1870.

In the year 1815 he commenced practice in Edinburgh as a family physician, and continued there in the same vocation all his life. He was most attentive to his duties, very gentleman-like in his bearing, and an agreeable, social companion. He possessed the regard and esteem of the late Dr Abercrombie, whose family he attended when any of its members were ailing. He was with Dr Abercrombie himself, during his last illness; and, after his death, he wrote a short biographical memoir of his friend and patient for the newspapers.

In the year 1839 Dr Hunter became a Fellow of this Society. He was a member of the Medico-Chirurgical Society of Edinburgh, and contributed a paper to its Transactions, on "Dislocations of the Shoulder and Hip-Joints." He was a life member of the British Association. In the year 1865, he published an interesting pamphlet of forty-one pages on the subject of Life Insurance; contrasting the London and Edinburgh offices, and showing the superiority of the latter, as regards honest administration and principles. He had been a policy holder in a London office, as well as in the Scottish Widows' Fund, and found how much more advantageous it was to be connected with the latter, than with the former.

Dr Hunter was employed by the Directors of the Scottish National Insurance Company to make a special report on the lives of the assured in that Company. His report, which was printed, received much commendation. He had been the medical adviser of that Company since the year 1843; as also of the English and Scottish Law Life Assurance Association, since the year 1847. On the occasion of his death, the Directors of both Companies passed minutes, expressing the very high regard which they entertained for him. Whilst his health remained, Dr Hunter's practice was extensive; and his patients had not only full confidence in his professional skill, but derived great comfort from his visits. One of them writes thus: "On more than one occasion he was the means, in the hand of God, of saving my life, and many, many times he has lightened my anxieties,

and cheered my heart, in a way no one but himself could do. God was good to me, in giving me such a valuable adviser."

In the year 1865, Dr Hunter underwent an operation for removal of a tumour in the throat. But the disease was not eradicated. The tumour re-appeared, and continued up to the period of his death, which took place suddenly.

Dean Ramsay, to whose congregation Dr Hunter belonged, after his funeral, alluded from the pulpit to him, in these terms: "He had for many years a very extensive medical practice in the families of this city, and no man more conscientiously, more carefully, and more sedulously performed the duties of his profession. From the presence of an impending and fatal malady, death had for some time been familiarised to his mind. But I know how he met that monition, as he met all the trials of life, with a firm trust in the love of his Redeemer, and with unshaken faith in the fulness of His atonement."

Dr Hunter, in October 1820, married Elizabeth, the eldest daughter of John Kircaldy, Esq., and by her had six children.

Edward Francis Maitland, known after his elevation to the judicial bench under the title of Lord Barcaple, was born in Edinburgh, 10th April, 1808, and died there 23d February 1870. He was the youngest son of Adam Maitland of Dundrennan, in the county of Kirkcudbright—a property which a Dr Cairns of London left to his niece, whom Mr Maitland married. Edward Maitland's elder brother was Thomas, who also was raised to the bench, under the title of Lord Dundrennan.

He received his education at the High School, and at the University of Edinburgh, and came to the bar in the year 1831. He was possessed of considerable ability, and also of much general knowledge derived from reading. He was shy and reserved, and had an awkward manner, so that his real merits were less known than they deserved to be. For many years he had little or no business as a lawyer, and at one time in consequence meditated a change of profession. During this period of involuntary professional idleness, he became editor of the "North British Review," and contributed to it several papers, which were characterised by vigour of thought, and correctness of composition. Being a

Whig in politics, when his friends obtained office, he received the appointment of Advocate-Depute. In the year 1851 he was made Sheriff of Argyle. In the year 1855 he was appointed Solicitor-General, which office he lost with the change of Government; but in 1859 it was restored to him. These professional appointments afforded an opportunity of showing his qualifications as a good lawyer, and an accomplished pleader; and business at length flowed in, so as to afford a handsome income. He was thoroughly conscientious in the fulfilment of his professional engagements. When Solicitor-General, it was remarked that he never missed being present in the Justiciary Court, and he was always well prepared with the business of which he had charge. There were several cases of public interest in which he was counsel,—one of them the famous Yelverton case. He was senior counsel for Miss Longworth, and evinced the utmost anxiety to have her claims properly presented. Shortly before her case came on for discussion in the Inner House, he received from the Crown his commission to the bench. But he withheld it for a week, that he might have it in his power to plead once more on Miss Longworth's behalf; and it has been stated, that it took him three days' hard work to prepare for the pleading. He declined to accept of any remuneration for his services in this case. His title of Barcaple was derived from a property of that name which he had purchased from his brother, David, a merchant in New York. It is situated in Kirkcudbrightshire, and I believe not far from the family estate of Dundrennan.

It was in 1862 that Mr Maitland was raised to the bench, and it was in the same year that he became a Fellow of our Society. But he did not contribute any papers, or often attend our meetings. He was the first representative of the Edinburgh University Council in the University Court. He was also the first Rector of Aberdeen University, after the union of King's and Marischal Colleges in 1860. Not being able to understand how Mr Maitland should have been thought of for this appointment, being in no way connected with Aberdeen, I wrote to my friend Principal Campbell for an explanation; and I have much pleasure in making the following extract from his answer:—

"His appointment to the office of Rector was the result of a

severe and bitter contest between the friends and the opponents of the union of the Colleges, or rather a portion of the latter, for the more sensible and disinterested opponents had by that time seen the necessity of acquiescing in the union, and of either facilitating or not impeding the working of the University under the new arrangements. The malcontents, whose object was to bring about a dead-lock and embarrass the Universities' Commissioners, induced a party of the students to set up the late Sir Andrew Leith Hay, who certainly would never have been thought of in other circumstances. The friends of peace and order chose Mr Maitland, *although*—I perhaps ought to say, *because*—he was totally unconnected with this locality and district, and yet well-known as a man combining a cultivated mind with the aptitude for academic business, as well as the firmness which our circumstances required.

"The votes of the *Nations* stood two to two, and the casting vote having fallen to me—the Chancellorship being vacant—I gave it in favour of Mr Maitland, although, owing to local influence and intimidation, the aggregate majority of individual votes was in favour of his opponent. I need not now say anything of the abuse and threats with which my decision was received by many in the town, of the childish and abortive application to the Court of Session for an interdict, or of the violence with which some of Sir A. Leith Hay's supporters attempted to interrupt the installation, and the Rector's address. All was amply repaid, to me, at least, by Lord Barcaple's great services to the University, in circumstances of difficulty which the authorities of a Scotch University have rarely, if ever, encountered—services which eventually gained for Lord Barcaple the esteem of most of his opponents, and the lasting gratitude of the friends of the University. He made the duties of his office a matter of conscience. Notwithstanding the demands on his time, of such a practice at the bar as his, he never hesitated to come to Aberdeen when required; and I can safely say that no Rector in Scotland, during his three years' tenure of office, has ever attended an equal number of meetings of Court and Council. His inaugural address was in a high degree sensible, elegant, and scholarly, but I do not remember that it was remarkable for anything in the topics or mode of discussion.

"Lord Barcaple was a Whig and a Free Churchman. I am neither. But there are few men whose memory I cherish with greater veneration."

Lord Barcaple's inaugural address referred to by Principal Campbell, I have, since receiving the Principal's letter, had an opportunity of reading. It contains an admirable summary of the duties of University students, and also of the temptations to which young men of their age are exposed. The language employed is correct and forcible—clearly indicating that Lord Barcaple was a person of high intellectual powers, and of cultivated mind.

Lord Barcaple, though of decided political views, was too conscientious to be a party man. His friends had looked forward to his holding the office of Lord Advocate, and going into Parliament. It was probably lucky for him that he did not undergo this ordeal, as the exercise of patronage in a party spirit would have been to him a perpetual misery. It is understood that, soon after he became judge, he regretted his elevation, as it not only greatly lessened his emoluments, but imposed on him more onerous duties than he was able comfortably to discharge. The death of Lord Manor, and the unaccountable delay on the part of Government in filling up the vacancy, threw on Lord Barcaple a very large amount of judicial work. The load proved too much, and he broke down; continuing, however, to the very last the performance of duty. If, in consequence of his reserved habits, Lord Barcaple had not many friends, he had no enemies. His amiable dispositions, and strictly truthful character, ensured to him a peaceful life, and the esteem of all who knew him.

Robert Nasmyth was born in Edinburgh in the year 1792. He died there, 12th May, 1870. He was educated first at the High School, and when about fifteen years old went to the University of Edinburgh. Intending to belong to the medical profession, he first became a pupil of Dr Barclay, then an extra-academical lecturer on anatomy. Ultimately he became his prosector, and was always seated beside him during the lecture. At first he seemed inclined to adopt surgery as his profession. In the year 1823 he became a Fellow of the Royal College of

Surgeons—Syme also being elected about the same time. He was intimate with Syme, Liston, Fergusson, and Wardrop, and often assisted these eminent surgeons when they operated. He afterwards went to London, and there was led to study dentistry. He probably foresaw, that there would be a favourable opening in Edinburgh, when Dr Law, who had a large practice as a dentist, died or retired.

Mr Nasmyth, when he began practice in Edinburgh, was the first who united the profession of a dentist, with the education and qualifications of a surgeon. He soon succeeded in obtaining public confidence.

He wrote very few scientific papers. The subject of his inaugural thesis had been "Tic Douleureux;" and, in the year 1843, he communicated to the London and Edinburgh Journal of Medical Science a comprehensive paper on the "Physiology and Pathology of the Teeth." I understand that most of the preparations in the Museum of the Royal College of Surgeons in this town, to illustrate the development of the teeth, were made by Mr Nasmyth.

The late Professor Goodsir was for seven years assistant to Mr Nasmyth, and has publicly acknowledged the valuable instruction he received from him. In 1842 Mr Nasmyth was elected a Fellow of the Royal Society of Edinburgh, but I do not think he contributed any papers or notices to our transactions. He was vice-president of the Odontological Society of London, and had been so for thirteen years before his death. He had held the offices of surgeon-dentist to King George IV., to King William, and also to Queen Victoria. He was a person of affable manners, and easy access. Dr Smith of Wemyss Place informs me that he kindly gave him much assistance in preparing the lectures which he delivered in Surgeon's Hall, and also in establishing the Dental Dispensary of Edinburgh.

Mr Nasmyth had in all four sons and four daughters. Two sons successively followed for a time their father's profession; but both died of consumption, as well as a daughter and another son. His third son was an officer in the artillery, and highly distinguished himself in the defence of Silistria.

Mr Nasmyth had a much larger and longer practice, in his

peculiar vocation, than any one before in Edinburgh. He was an agreeable companion, a fast friend, and possessed of much general knowledge. He will long be remembered as a skilful dentist, and a highly respected citizen of Edinburgh.

JAMES YOUNG SIMPSON was born 7th June 1811, and died 6th May 1870, being at the time Professor of Midwifery in the University of Edinburgh. His birthplace was Bathgate. The house in which he was born, is, I understand, still standing. It is a two-storeyed slated house, part of which has been converted by his brother Alexander into a hall used for meetings of various kinds. His father kept a baker's shop. His grandfather was a small farmer. He was the youngest of seven sons; and was sent by his father to the parish school.

He was sent to Edinburgh University to study medicine, and his expenses there were paid by his eldest and now only surviving brother, Mr Alexander Simpson of Bathgate, to whose kindness and brotherly care he was infinitely indebted. His parents both died when he was young. Whilst studying in Edinburgh, he lodged with his brother David, then in business as a baker in Stockbridge.

His taste for books in his boyhood was remarkable. He was constantly to be seen sitting at the corner of the fireplace devouring any books he could get, and oblivious of the talking or noise around him.

In the Humanity Class, he attracted the attention and patronage of Professor Pillans, who, learning that he wished to study medicine, but that he was scant of funds, recommended him to compete for a bursary endowed for the support of boys of the name of Stewart or Simpson. This advice he followed. An extended study of Latin and Greek was however required. He succeeded in gaining the bursary, thereby drawing £10 yearly for three years.

In the year 1832 he obtained his medical degree, and was imme diately afterwards elected by his fellow-students—among whom he had become a favourite—to be Senior President of the Roya Medical Society of Edinburgh,—an institution which, for about a century and a half, has been supported chiefly by the University medical students.

Young Simpson's graduation thesis so pleased Professor John Thomson, who held the Pathological Chair, that he made him assistant in his house, and employed him in the arrangement of his library; and in this new position he made rapid progress, not only sucking in all the knowledge which the Professor possessed, but venturing on views and speculations of his own. He was permitted occasionally to read the Professor's lecture to the class when the latter was unable from feeble health to do so—the Professor himself, however, being generally present. It seems that young Simpson did not always confine himself to the mere reading of the lecture, but presumed occasionally to introduce verbally an exposition of his own ideas, to the surprise of both students and Professor. The latter, on one occasion, having heard some new and startling propositions from the chair, after the lecture was over, expressed his dissatisfaction in the retiring-room by saying to his young assistant, "I don't believe one word of it, sir."

Simpson having acquired some confidence in his own powers, thought of setting up for himself; and seeing in the newspapers an advertisement that a doctor was wanted to attend the poor in the parish of Innerkip on the Clyde, he offered himself. But he was rejected. He used to say that he felt this disappointment more keenly than any he ever met with in after life. I may add here what I think Simpson once told me, that an old-established medical practitioner in a town not far from Edinburgh, wishing to get a young licentiate as an assistant, and who might ultimately become a partner, gave out a subject for an essay among the medical students of the Midwifery Chair, intending to judge of their qualifications partly by their essays and partly by conversation. Simpson gave in an essay, and was one of those sent for, but was again doomed to disappointment; though from this village doctor he received much friendly counsel and a promise of future patronage.

During the next two or three years, he continued to prosecute his studies, chiefly in obstetrics, and read several papers in the Royal Medical Society. He also visited France. He now began to form a museum of preparations and objects bearing on anatomy, and at length announced his intention of giving public lectures. These he continued for three years, and they obtained so much

success, that he probably then conceived the idea, in the event of a vacancy in the University Midwifery Chair, of offering himself as a candidate.

In the year 1839 the venerable Dr Hamilton, who occupied that chair, died, on which event Simpson became a candidate, supporting his claims by an octavo volume of 200 pages of testimonials, and accompanied by a catalogue of the museum which, in the short space of three years, he had formed, containing no less than 700 obstetric preparations. The assiduity with which he plied his canvass, and the steps he took to overcome objections, may be judged of from the circumstance that one of the magistrates (the present Lord Provost of this city) having stated it as a drawback, if not a disqualification, that he was an unmarried man, Dr Simpson replied, "I admit it is a disqualification, but it may perhaps be removed." The next day he started for Liverpool, and contracted a marriage there with the daughter of Mr Walter Grindlay. In about ten days thereafter, he returned to Edinburgh; and having called on Bailie Law, he informed him of the step he had taken in deference to his opinion, and then claimed a promise of his vote—which he at once received. It was by that vote he won the Professorship.

After Simpson was elected, there were confident predictions that the obstetrical class in the University would fall off, and that many fewer patients would come to Edinburgh to be under the Professor's care. Animadversions fell freely on the magistrates, as patrons of the chair, for electing a man without either experience or reputation, instead of his opponent, who had both. These anticipations soon proved to be utterly unfounded. After Simpson's election the Midwifery Class was crowded. Not only did students flock to it in greater numbers even than formerly, but medical officers of the navy and army, when home on furlough, frequently attended to hear the original views of the youthful Professor, and were delighted by the aptness of his illustrations and the earnestness of his style of lecturing.

He also carried on obstetric investigations and experiments on various points of difficulty, accounts of which were given by him from time to time in papers read at Societies, or inserted in medical journals. He soon came to be employed extensively

as a practitioner, so that he had abundant opportunity of seeing cases, both novel and instructive, and of trying improved methods. At the same time, he was acquiring a complete knowledge of all that had been written by others, not only in Europe and America, but even by the Greeks and Romans,—his good classical knowledge in this respect proving serviceable. He allowed himself very little sleep; and even in the houses of his patients, whilst waiting in an adjoining room till his services were required, used to write out papers, or arrange materials for them.

His mind was so exuberant and versatile, that it often flowed over and beyond the pale of his own special department. Thus, one of his papers read before the Medico-Chirurgical Society in 1841 was entitled, "*Antiquarian Notices of Leprosy and Leper Hospitals in Scotland and England.*" Another had this title, "*Was the Roman Army provided with Medical Officers?*"

His great delight, and therefore his incessant aim, was to search out something new; and for this purpose, whilst he ransacked his own brain, he did not disdain to rummage among the rubbish of old authors, or to talk with any one who had anything to communicate on any topic whatever. One of the subjects, in his special department, which interested him greatly, was the use of anæsthetics. He had read of the experiments performed in America by several surgeons and dentists, to render their patients insensible to pain by inhaling sulphuric ether. He did not see why this substance should not be used in obstetric practice. Accordingly, he administered it to one of his patients for the purpose of lessening the pains of parturition. This case occurred on the 19th January 1847. Before that time, no one had ventured on such an experiment. It was entirely successful; and he thought it so important that, next day, he communicated the discovery to his class, and gave a special report of it to the Obstetric Society. The case got into the newspapers, and within ten days the process was repeated successfully in the hospitals of London and Paris. During the following six months, Dr Simpson continued the use of sulphuric ether both in the Edinburgh hospitals and in private practice, resorting to it, however, only in cases where nature had to be assisted. Simpson found several drawbacks in the use of sulphuric ether, and in consequence began to search for something

better. One of the many substances he tried was chloroform,—a liquid discovered in 1832 by two German chemists, and first accurately investigated and described in 1835 by Dumas of Paris. The trials which Professor Simpson made with the vapour of this substance, and which led him to adopt it, took place in November 1847. But it is right to add that, though he discovered its suitableness for the purpose wanted, and was the first to introduce it into surgical practice, the idea of so using it, had occurred to others previously, and trials had even been made with it. Thus Bouchardat, in a book called "*Nouveau Formulaire Magistral*," published in 1845, and a copy * of which Professor Simpson was possessed of, under the head of "Chloroforme," observes—

"Cependant on peut se croire autorisé à regarder l'effect du Chloroforme comme antispasmodique, et à penser, que si une grande analogie de composition rapprochait cette substance des *ethers*, une *grande analogie d'action était également commune à chacune de ces substances.*"

Another French physician, Flourens, read to the Paris Academy in March 1847 a paper on the properties of chloroform, mentioning a number of experiments he had made of its effects on animals, and adding that "*he did not think it could be used with safety in medical practice.*"

Besides the information or hints derived from these sources, it must be added, that a Mr Waldie of Liverpool, who was chemist to the Apothecaries' Company there, being in Edinburgh during the month of October 1847, called on Professor Simpson; and on the Professor telling him that he was seeking for some better anæsthetic than sulphuric ether, Mr Waldie spoke to him of *chloric ether*, and *advised* him to try *pure chloroform* unmixed with alcohol. He asked Mr Waldie to submit to anæsthesation by chloroform, but Mr Waldie was not willing to risk the experiment.

Acting on this hint, Professor Simpson procured—I believe from Professor Gregory—a small quantity of pure chloroform, which, however, he did not at the moment make use of. It was put aside, to be tried with other substances at some more convenient opportunity. Late one evening—it was the 4th November 1847—to quote from Professor Miller's pamphlet, Professor Simp-

* I state this, on the authority of the Editor of the Edinburgh Medical Journal for Nov. 1870, p. 441.

son resumed his experiments, aided by his two friends and assistants, Drs Keith and Matthews Duncan—

"Having inhaled several substances, but without much effect, it occurred to the Professor to try a ponderous material, which he had formerly set aside on a lumber table, and which, on account of its weight, he had hitherto regarded as of no likelihood whatever. That happened to be a small bottle of chloroform. It was searched for and recovered from beneath a heap of waste paper. With each tumbler newly charged, the inhalers resumed their vocation. Immediately an unwonted hilarity seized the party. They became bright-eyed, very happy, and very loquacious—expatiating on the delicious aroma of the new fluid. The conversation was of unusual intelligence, and quite charmed the listeners—some ladies of the family, and a naval officer, brother-in-law of Dr Simpson. But suddenly there were sounds like those of a cotton mill, louder and louder. A moment more, then all was quiet; and then—a crash. On awaking, Dr Simpson's first perception was mental. 'This is far stronger and better than ether,' said he to himself. His second was, to note that he was prostrate on the floor, and that among the friends about him there was confusion and alarm. Hearing a noise, he turned round and saw Dr Duncan beneath a chair, his jaw dropped, his eyes staring, his head bent half under him,—quite unconscious, and snoring in a most determined manner. More noise still, and much motion, caused by Dr Keith's legs making valorous efforts to overturn the supper-table. By and bye, Dr Simpson having regained his seat, Dr Duncan having finished his uncomfortable slumber, and Dr Keith having come to an arrangement with the table, the sederunt was resumed. Each expressed himself delighted with the new agent, and its inhalation was repeated many times that night—one of the ladies gallantly taking her place at the table—until the supply of chloroform was exhausted. In none of these subsequent inhalations, however, was the experiment pushed to unconsciousness. The first event had quite satisfied them of the agent's full power in that way. The festivities on the occasion did not terminate till three in the morning."

Such is the graphic account given by the late Professor Miller of the way in which Simpson discovered the properties of chloroform vapour. The value of the discovery depends upon the superiority of chloroform to sulphuric ether, the anæsthetic previously employed in medical practice; and its superiority was manifested thus, viz.—1*st*. That a much less quantity of chloroform answered;—2*d*. That insensibility came on more rapidly;—3*d*. That no special instrument for its administration was required;—4*th*. That the odour was more agreeable.

On the 8th November 1847, this new anæsthetic was employed by Professor Simpson in a case of labour for the first time, and with complete success. It soon became known in the profession,

and it has in this country almost superseded every other anæsthetic, both for aiding parturition and for numberless surgical operations. In these operations, especially, it has been of incalculable service, not only by relieving from suffering, but by saving life. I observe a statement by an American army physician made lately at a public meeting in Washington that—*

"In the Crimea and Italian campaigns, chloroform was employed without a single disaster. A similar result attended its use during the seven weeks' Austro-Prussian war. In our own unhappy struggle [he alludes to the American Civil War] chloroform was administered in more than 120,000 cases, and I am unable to learn of more than eight cases in which a fatal result can be fairly traceable to its use."

The immense quantity of chloroform manufactured, is a sufficient proof of the trust universally placed in it, and of the immense amount of human suffering relieved by it. In October 1869, when the freedom of this city was bestowed on Simpson, he mentioned that the distinguished firm of apothecaries in Edinburgh, who manufacture chloroform, were making it in such quantities as to yield about 8000 doses daily. On inquiry last week, I learnt from Mr Flockhart, that the quantity of chloroform now manufactured in this town is about double what it was a year ago, partly in consequence of the sanguinary European war which has raged for the last five months, but chiefly in consequence of the rapidly increasing use of chloroform in general practice. Mr Flockhart told me that just before Paris was invested, he sent to the medical staff there 1000 bottles of 1 lb each,—which he heard had reached their destination. He also sent 800 bottles to the Germans. These went chiefly to the army of the Crown Prince.

Numerous were Simpson's discoveries and improvements, even in departments of medicine which lay outside of his own special field. The stopping of hæmorrhage from cut arteries is effected by ligatures or torsion. He proposed pins or needles, by which to close the artery.

With a view to arrest the spread of epidemics, he urged the complete isolation of the patients affected; maintaining that, as rinderpest could be stamped out by the immediate slaughter of cattle attacked by it, so scarlet fever, measles, hooping-cough, and

* Ed. Med. Journal for Nov. 1870, p. 473.

even small-pox might be, if not extinguished, at all events arrested, and so cease to be epidemic, by strict confinement and complete isolation of the first individual attacked.

His views on the subject of large hospitals were founded on the same principle. He insisted that, where large numbers of sick persons were accommodated in one building, the atmosphere of the building became tainted, so that the patients had less chance of recovery; and this position he attempted to prove, by contrasting the proportion of recoveries in hospitals with those in private dwellings.* On these grounds Simpson advocated the abolition of large hospitals in towns, and the substitution of detached cottages in the country; but if hospitals were to be retained, then instead of wards, with from fifty to one hundred beds in each, and reached by lobbies and staircases inside of the house, he urged that the wards should contain as few beds as possible, and that access should be had to them by stairs outside of the hospital altogether.

That the principle on which these views are based, as to the expediency of isolating persons afflicted with any complaint whatever, is a sound one, none can doubt, who has read the recent discoveries of minute and invisible organic dust in the atmosphere, consisting in many cases of germs—germs which, inhaled, and entering the blood, engender diseases in the body.

I see it stated in a well-informed medical paper that, among

* In the speech which he made on receiving the Freedom of the City, he remarked that—"When such a simple operation as amputation of the *fore-arm* is performed upon a poor man in the country, and in his own cottage home, only about one in 180 dies. But the statistics of our large metropolitan hospitals disclose the stern and terrible truth, that if these men had been inmates of their great wards, thirty of them, or about one in six, would have perished; a fact, among many others, which calls earnestly and strongly for some great reform in our large hospitals, if these institutions are to maintain their ancient character as the homes of charity and beneficence." These statistics applied to the amputation of the *arm*. He gathered similar statistics from the hospitals, and from country practitioners, in regard to amputations of the *leg*, which showed that these amputations in like manner were always more successful in the country than in town hospitals, notwithstanding the greater skill of town surgeons; and he deduced the following conclusions:—"1*st*. That about three times as many patients die after *limb* amputations in our large hospitals, as die from the same operations in private and country practice. 2*d*. That to reduce the death-rate from operations in our surgical hospitals, we should strive to assimilate their form and arrangements to the condition of patients in private and country practice."

Professor Simpson's unpublished papers, some notes have been found bearing on hospital reform. That he felt there was something more which he could have done on that subject, is evident from a remark made during his last illness, when informed that his recovery was doubtful. He said that his principal reason for desiring a prolongation of life, was that he might do a little more service in the cause of hospital reform.

These suggestions for improved practice, in the various departments of the medical profession, exposed Professor Simpson to much controversy. Naturally zealous and ardent, and knowing that energy and perseverance were required for any reform which was likely to disturb old customs, or existing interests, he frequently drew down on himself opposition of a disagreeable and personal character. Thus, with reference to his proposal to substitute acupressure for deligation, the Professor of Clinical Surgery, in the same University, complained bitterly of his interference in matters alien to the midwifery chair; observing that *he* had not interfered, as he might have done, to denounce certain useless and often dangerous innovations introduced in the treatment of diseases of women.

The amount of private practice which Professor Simpson obtained, not only in his own special department, but even in other cases, is probably greater than any one ever before possessed. No other result could be expected, as the discoveries and improved practices which emanated from him, indicated not only knowledge to an immense extent, but inventiveness in meeting the most difficult cases. He had also an agreeable expression of countenance, and a melodious voice, qualities which, in a sick room, made his attendance doubly acceptable. I have often seen in his house, after two o'clock, a levee of patients of all classes, rich and poor, amounting sometimes to hundreds, desirous of consulting him. Not only were the drawing-room, dining-room, and library filled, but even the lobby and passages. Frequently persons had to leave without being able to see the Professor, after waiting two hours. A relative of my own, having succeeded in catching him as he looked into the room where she was waiting, told her case to him. He then, without saying anything, left the room, but immediately returned with a

book, in which he pointed out to her the part where she would find her ailment described. He asked her to read it whilst he went to another patient, promising to come back in a few minutes. Having read the passages, and waited patiently an hour, she rang the bell to inquire for the Professor, and found he had left the house, having forgotten his promise to return.

Professor Simpson was untidy in his dress, and on one occasion much offended a lady of rank who called on him at his house, by coming to see her in his "stocking soles." Frequent complaints were made by patients, as to his want of punctuality in returning to visit them. One lady, having been desired by him to remain in bed till he returned again in a day or two, remained ten days in bed, waiting for his return. He had been called to the country, and had forgotten this town patient altogether.

It was indeed not to be wondered at that, with such multitudes of objects engrossing his thoughts, he should be occasionally distracted and diverted from his professional engagements. Nevertheless, so great was the confidence reposed in his skill, that these breaches seldom caused patients to forsake him. Traps were often laid to catch him for attendance, or a consultation. With that view persons went to his house to breakfast though uninvited, and they were always graciously received. Sometimes when they saw his carriage standing at a door, they used to get into it and wait till the Professor came out from his visit.

It has been estimated, by those who had means of knowing the extent of Simpson's practice, that the number of strangers who came to Edinburgh for his advice and treatment, must have caused an expenditure of at least £80,000 a-year among the hotel and lodging-house keepers.

It is obvious that, on account of Professor Simpson's extensive practice, the instruction which he was capable of giving must have been most valuable. Nor was it only in the class-room and to students, that instruction was given by him. He was ever accessible to his professional brethren, and particularly to country practitioners, when they were at a loss in cases of difficulty. One of this last class,* who frequently resorted to him, having been

* Dr Turnbull of Coldstream. He has allowed me to quote from his letter.

asked by me for any notices of his deceased friend, wrote as follows:—

"My own success in practice has been far beyond anything I ever anticipated when I commenced it, now upwards of a quarter of a century since and, beyond all question, I feel indebted to Simpson, more than to all my other teachers put together. He was loveable and winning to an extent which no words of mine can express. I spent the forenoon of the day on which he returned from the Mordaunt trial with him. Then he performed upon a patient of my own, a difficult operation, on which he showed great resource and skill, probably the last operation of importance he did. He gave me an account of the trial, and of Serjeant Ballantyne's examination. He inquired most anxiously about Dr Watson's lecture given the previous night at the Royal College of Surgeons,* at which I was present, and at his absence from which he expressed great regret. A part of the day on which he died, I spent with Dr Warburton Begbie; and when he told me that I would never see Simpson again, adding 'I know full well how genuine has been your mutual friendship for many long years,' I could give no reply. The tears stole down my cheeks, and I experienced then, and many a time since, a genuine sorrow which I need not describe. To his faults I was not blind, and for them he has assuredly been sufficiently abused by those who think that he only was blameworthy. While I live, I shall never cease to think of him, as I always found him, generous, attractive, and loveable, far beyond any other man whom I ever met."

Let me add, that he did not confine his teachings and counsel to students and to medical practitioners. To all and sundry who chose to consult him, and who could obtain access to him, he was ever ready to open up the stores of his wonderful memory and inventiveness. On the last occasion that I had a lengthened conversation with him, he adverted to the future prospects of medical discovery, and pointed out that these would depend more on the chemists than on any other class of investigators. He remarked, how little we yet knew the reasons why particular medicines were efficacious in arresting disease, and said that he thought no medical student should receive a licence who was not an expert chemist.

Whilst ready to teach verbally, whether in the University, or in medical societies, or in his own house, he had little taste for writing medical books, but it was a recreation to him to write on archæological subjects. The two large volumes on obstetrics, which bear his name, were published, not by him, but by two medical friends, who undertook the labour of collecting and arranging his papers and

* The subject of lecture was Hospital Reform.

notices, published and unpublished. In the few words of preface to the first volume, written to express his gratitude to Dr Priestley and Dr Storer who edited the work, Professor Simpson states that most of the communications, which appeared in it, "were written hurriedly, and amid the incessant distractions of practice." He adds, "If I had attempted to remodel, extend, and correct them, they would never have been published in a collected form." Why not, he explains in his preface to volume second, in these words, "The life of a busy accoucheur, is not a life fitted for literary work. Besides, I am quite deficient in some of the principal qualifications generally laid down as requisite for success in medical authorship; having no heart or habit for the daily written annotation and collection of individual cases and observations—no sufficient industry and endurance for the pursuit of any tedious and protracted investigation, and no great love of lifting my pen, but the very reverse."

The reasons thus assigned by Professor Simpson why he would never have published these two volumes, must, of course, be accepted. But there was probably another and a stronger reason, which it might have been thought ostentatious for him to mention, —and that was his insatiable love of discovery—his constant desire to be ever searching for new truths, and to occupy as much of his time as possible on fields where these truths were likely to be found. He would have considered it a waste of time to have gone back on his own previous researches, in order to present them again before the world in the form of a published work. That was a mechanical labour which he willingly and wisely handed over to the kind friends who voluntarily undertook it, and thus he was left free to apply his time and talents to the nobler business of advancing human knowledge by fresh discoveries.

His active and buoyant mind, not finding enough to occupy it within the circle of medicine, sought more work in other fields, and hence he was led to become a member of various societies of a scientific character. The first that he joined after becoming Professor of Midwifery, was *our own Society*. He joined it in the year 1844, and contributed the following papers, which were read at our evening meetings, and afterwards printed in our Proceedings:—

On the 16th December 1850. Notice of a Roman Practitioner's Medicine Stamp, found near Tranent.

On the 6th March 1857. History of an Anencephalic Child.

On the 19th December 1859. On Acupressure, a New Method of arresting Hæmorrhage.

On the 6th April 1863. Note on the Anatomical Type in the Funis Umbilicalis and Placenta. (Transactions, Vol. XXIII.)

On the same night. Note on a Pictish inscription in the Churchyard of St Vigeans.

On the 2d January 1866. Notices of some Ancient Sculptures on the walls of caves in Fife.

On the 26th January 1868. Pyramidal Structures in Egypt and elsewhere; and the objects of their erection.

With reference to this last paper, the chief purpose of which was to refute Professor Piazzi Smyth's theory about the origin and object of the Great Pyramid of Egypt, it has been publicly stated, by a person who alleges he knew the fact, that to enable him to test the correctness of Professor Smyth's calculations, and to write the papers above referred to, he devoted three weeks to a study of decimals and a perusal of astronomical works;—a proceeding which shows the zeal and energy with which, even at a late period of life, he could take up a new subject.

Another Society, unconnected with the profession which he joined, and in the business of which he took almost inconceivable interest, was that of the *Antiquaries* of Scotland. Every volume of the "Transactions" of that Society, after he joined it in the year 1859, teems with notices from his pen; and a very considerable number of the articles in the Society's instructive museum were donations from him. I have heard that he had formed a kind of map or glossary applicable to both England and Scotland, showing the sites of curious old buildings, camps, or standing stones; so that on the occasion of making any professional visits to districts where these relics occurred, he might contrive to see them.

When made a Vice-President of the Society of Antiquaries, he delivered an address, which for archæological lore and acquaintance with the early history of Scotland, astonished those who had made this subject a special study all their lives. This address was

published, and had a motto from Wordsworth prefixed to it, truly expressive of the heartfelt pleasure which these researches gave to him. The motto was—

> "I have owed to them
> In hours of weariness, sensations sweet
> Felt in the blood."

I remember being so struck with this address, that after reading it, I begged a common friend to ask Sir James, how and when he had found time to compose it. His answer was, that he had written it, after twelve o'clock at night, as he always felt refreshed by writing papers of that kind. There is a paragraph at the conclusion of this address, which deserves to be quoted for its own sake, and because it led to an occurrence which illustrates Professor Simpson's readiness to aid in any good object.

> "In the name of this Society, and in the name of my fellow-countrymen generally, I here solemnly protest against the perpetration of any more acts of useless and churlish Vandalism in the needless destruction and removal of our Scotch antiquarian remains. The hearts of all leal Scotchmen, overflowing as they do with a love of their native land, must ever deplore the unnecessary demolition of all such early relics and monuments, as in any degree contribute to the recovery and restoration of the past history of our country and of our ancestors. These ancient relics and monuments are in one sense national property, for historically they belong to Scotland and to Scotsmen in general, more than they belong to the individual proprietors upon whose ground they happen to stand."

Shortly after this address was published, a visit was paid by the Berwickshire Naturalists' Club to a remarkable old fortress in Berwickshire, called Edins Hald, situated among the Lammermuir Hills. Those members of the Club who had known the building in former years, were distressed to see how much it had been mutilated, and to hear, that it was about to be again used as a quarry, for some stone dykes soon to be erected. The Club addressed the proprietor on the subject, with the view of obtaining a promise to prevent farther dilapidation. He, however, showed no disposition to grant our request. We resolved then to submit the matter to Professor Simpson, on the faith of the admirable address to which I have just adverted. It turned out fortunately for us, that the wife of the proprietor, who resided near Edinburgh, was then attended by Professor Simpson. He willingly undertook to intercede with her on behalf of this old relic, and obtained from

her husband a letter containing a written promise to have the ruin protected from further injury; which letter he handed over to the secretary of the Society of Antiquaries.

Professor Simpson made several visits to Northumberland, to examine the sculptured rocks at Old Bewick, Doddington, and Roughting Linn, as well as to inspect the excavations of the British forts, dwellings, and sepulchres on Yevering Bell, among the Cheviot Hills. On one of these occasions, he joined a meeting of the Berwickshire Naturalists' Club—of which club he was a member; but not being able to keep up with the party, walking through long wet brackens, and over rough moorland, he borrowed a horse. Not being a good rider, he soon came to grief, in a bog which had to be crossed. The horse finding himself sinking, reared, and tumbled the Professor into the mud, out of which he was extricated, with some difficulty, and to the no small detriment of garments. After getting through the bog, he valiantly mounted again, glad to have that method of reaching the top of one of the highest of the Cheviots.

One of the archæological topics on which Professor Simpson wrote an interesting paper, was a history of the Oratory on the island of Inchcolm. I understand that he had collected materials for a similar account of all the islands of the Firth of Forth—on most of which there are still traces of ancient ecclesiastical edifices. I know also, that he had begun to write an account of the Roman Wall, extending between the Firths of Forth and Clyde, as he once spoke to me on the subject, wishing to know my opinion of Mr Geikie's theory, that this district of Scotland had risen twenty or thirty feet out of the sea, since the wall was erected. It is to be hoped that if his MSS. on these subjects are found, they will be put into a proper form for publication.

*Animal Magnetism*, *Mesmerism*, *and Biology*, were subjects, which at an early period, he studied; and for a time he was much impressed with the phenomena:—so much so indeed, that he used to hold "seances" in his own house, and show that he himself possessed a certain strange power over others. I have heard of his even performing in the houses of his friends, at evening parties,—when selecting some one, whom by a mere glance he discovered to be particularly nervous or sensitive, he would show

how completely a strong will could so influence the mind of another, as to cause confusion of ideas almost amounting to imbecility.

This meddling with mesmerism brought the Professor into some disrepute; and he was severely attacked in the Medical Journals, for his supposed credulity. At first, he took no notice of these attacks; but in consequence of the solicitation of his friends he in September 1851, published a letter in the "Lancet" explaining the object of his miscalled "mesmeric soirees." In that letter he says—

"During the last ten or fifteen years, I have repeatedly seen experiments, and also made them myself. In the course of them I have witnessed very interesting physiological and psychological results, such as the production of deep sleep, fixture and rigidity of muscles, &c. But I have no belief whatever, that these phenomena are the effects of any power, force, or agency such as is understood by the term '*animal magnetism*,'—passing from the so-called 'mesmeriser' to the so-called 'mesmerised.' They are merely the effects produced by the mind of the 'mesmerised' upon his or her own economy;—self-mental acts so to speak. These may no doubt be produced by the influence of the will of one individual acting on another. But they are no proof of any magnetic, mesmeric, or other supposed agency. In proof of my utter disbelief in *clairvoyance*, I may state that having sometime ago been present at a lecture on the subject, I offered to place L.100 in the hands of the President of the Medico-Chirurgical Society which he was to give to the lecturer, if the latter would bring any clairvoyant, who could read a line of Shakespeare, or two or three words out of a dictionary, which he (Professor Simpson) would shut up in a box."

Professor Simpson had no patience for the quackery and credulity of spirit rapping; and as Faraday condescended to expose "table turning" by a written opinion which he sent to the "Times" newspaper, so in like manner Professor Simpson took occasion, in the course of his address to the Society of Antiquaries, to remark—

"In our own days many sane persons profess to believe in the possibility of summoning the spirits of the departed from the other world back to this sublunary sphere. When they do so they have always hitherto, as far as I have heard, encouraged these spirits to perform such silly, juggling tricks, or requested them to answer such trivial and frivolous questions as would, to my humble apprehension, seem to be almost insulting to the grim dignity and solemn character of any respectable ghost. If, like Mr Home, I had the power to call spirits from the vasty deep, and if the spirits answered the call, I, being a practical man, would fain make a practical use of their presence. Methinks, I should next ask them hosts of questions regarding the state of society, religion, the arts, &c., at the time when they themselves were

living denizens of this earth. Suppose that our Secretaries, in summoning the next meeting of this Society, had the power of announcing in their billets that a very select deputation of ancient Britons and Caledonians, Picts, Celts, Scots, and perhaps of Scottish Juranians, were to be present in our Museum for a short sederunt between midnight and cock-crowing to answer any questions which the Fellows might choose to ply them with, what an excitement would such an announcement create! What a battery of quick questions would be levelled at the members of this deputation on all the endless problems of Scotch archæology."

About the same time Professor Simpson took part in the discussions which agitated the medical world on the subject of *Homœopathy*. At a meeting of the Edinburgh Medico-Chirurgical Society, the following motion was made by Professor Syme, and seconded by Professor Simpson :—"That the public profession of Homœopathy shall be held to disqualify for being admitted, or remaining a member of the Society." Professor Simpson supported this motion by a very able address, which he afterwards expanded into a book. This, as well as the reply to it by Professor Henderson, shows an immense extent of reading and information.

Another subject which deeply engaged Professor Simpson's attention was the so-called *Bathgate coal*, and also the *shales* of the Scotch coal fields, on account of the petroleum which they yielded by proper treatment. I have seen the outer lobby of his house in Queen Street greatly obstructed with huge specimens of the various kinds, and occasionally he spoke to me regarding them ; not so much in their geological relations as in their mercantile value and uses. It is matter of notoriety that Professor Simpson joined one or more of the companies which were formed for the purpose of extracting oil from these beds, and it is understood that he suffered considerable losses in consequence.

The number and variety of topics which thus engaged Simpson's attention—professional, scientific, literary, and speculative—implied an activity of mind, a grasp of intellect, and a strength of constitution truly marvellous. His inquisitiveness on almost all subjects was incessant. "Anything new turned up in Berwickshire?" was the first question which he generally put to me when on coming to Edinburgh I happened to meet him,—hoping probably to hear of more Picts' houses discovered, or more relics

found at the old Broch on Cockburn Law. His greatest delight and recreation was to explore ancient ruins, caves, and encampments; to decipher inscriptions or sculptures on standing stones or rocks; and to explore the rubbish of antiquated chronicles or musty parchments. Legends, superstitions, and charm stones were not beneath his notice, and were carefully studied, in the hope of extracting from them some gleam of historical truth. As a ray of sunlight enters a prism colourless and comes out radiant with beauty,—so these old inscriptions, sculpturings, and legends, after passing through Simpson's scrutiny, often appeared in a new light, and gave out a meaning not before suspected.*

His memory was surprising. Notwithstanding the legions of books which he read,—notwithstanding the numbers of places he visited, and the multitudes of facts which he gathered up at these visits,—he made no notes, and kept no diary, as most persons have to do. Any information obtained, whether from his own observation or from other persons; or any new views expressed on subjects which interested him, he seldom forgot; and could at once reproduce or refer to, when necessary.

Professor Simpson, engaged as he was in the teaching of youth, and attentive to subjects of public interest, could scarcely avoid taking some part in the educational discussions which have occurred during the last ten or twelve years in Scotland. The points he chiefly urged for improving public instruction were peculiar, and gave surprise to many of his friends. As President of the Granton Literary Association, he, in November 1867, delivered an address or lecture, which was published, "on the necessity of some change in the mode and object of education in schools, *in reference to modern and ancient languages.*" In this lecture the following pithy sentences occur:—

"Should they teach the *modern* languages, that are throbbing with life and activity? or should they teach the *old* languages of Greece and Rome spoken 2000 years ago?

"Was it right that one-seventh of a man's life should be spent in the acquisition of these dead languages? For the clerical profession, he admitted

* As examples, see Simpson's paper on "*The Cat-stane; Is it not the Tombstone of the Grandfather of Hengist and Horsa?*" Also to his paper "*On Ancient Sculpturings of Cups and Concentric Rings in Scotland.*"

this was a necessary study. But it was no longer necessary for the mass of the people.

"It was said that Latin and Greek were the best training. This he thought a great error; for the faculty called into exercise was chiefly memory. The power of observation required in science and art was called little into play, and the reasoning power of the mind became stunted and deformed;—to such a degree, indeed, that the students were ignorant even of their own ignorance."

In like manner, in his address to the Society of Antiquaries, he took the opportunity of undervaluing classical education, by such declarations as these:—

"Archæology has gained for us a clearer and nearer insight into every-day Roman life and habits, than all that *classic literature* supplies. Archæology, by its study of the old works of art belonging to Greece, has shown that a livelier and more familiar knowledge of that classic land is to be derived from the contemplation of its remaining statues, sculptures, gems, models, and coins, than by any amount of school-grinding at Greek words and Greek quantities."

It is the more surprising that such views as these should have been put forth, considering the frequent and good use to which Professor Simpson put his own classical information. In his papers on "*Roman Medical Stamps*," and "*Was the Roman Army provided with Medical Officers?*" he was able to give information, not only interesting, but instructive and useful, both papers displaying an extensive and intimate acquaintance with Greek and Roman authors. In his work on Anæsthetics, he devotes two chapters to obviate the theological objections taken to their employment to lessen the pains of child-bearing, and in these chapters discusses the true meaning of the Hebrew text of certain scriptural passages.

I have hitherto spoken of Simpson chiefly as regards his professional knowledge and his varied scientific and intellectual attainments. But it would be wrong in me to pass over unnoticed other features of his life and character quite as remarkable. He was a man of strong emotions. It of course depended on the exciting cause, how these influenced him. When attacked professionally or otherwise;—or when, after he had set his heart and hand to the attainment of some object, he found himself opposed, he was like a war-horse in a battle-field. His impetuosity sometimes carried him too far, brought him upon dangerous ground, and caused him to resort to means for accomplishing his ends

which he himself afterwards regretted. He hit his opponents severely, and I think even in this room expressions dropped from him which, in a scientific discussion, were out of place. But he was not of an unforgiving temper. I myself know, that he could offer the hand of reconcilement, after a contest was over. I saw the other day in a medical newspaper * a statement that not long before his death, he sent letters to some of his professional brethren whom he thought he might have hurt in the heat of controversy, expressing regret and asking forgiveness. Being curious to know whether this was really the case, I applied to one of the medical gentlemen who attended him during his last illness, and he informed me that he did not know of any *letters* to that effect; but he knew of a *message* having been sent to one professional gentleman, then also unwell, with whom there had been bitter controversy and long estrangement,—and the result was complete reconciliation.

I have already alluded to the multitudes of patients who every day thronged his house. The poor always could rely on getting advice from him gratuitously. But he was never very exacting from any class; and when persons in a better rank of life, who had come for advice, were discovered by him to be in greatly embarrassed circumstances, he is known to have generously helped them.

Two examples of this generosity may be mentioned. A lady whom he had attended was recommended by him, for the cure of her ailment, to go to a certain watering-place. Tendering to him such a fee as she was able to give, and for the smallness of which she apologised, the lady mentioned that the expense of going there would put it beyond her power. Simpson said nothing at the time, but afterwards in the most delicate way returned the fee, and enclosed £20 to enable her to obtain the means of cure which he had recommended. The other case was the wife of a New York merchant who had come to Scotland to be under his care. Whilst here, her husband died, and in bankrupt circumstances. Shortly after this, intelligence reached her that her only son, whom she had left at New York, was ill with a dangerous fever. She resolved at once to return home, though she was to have remained longer

* Medical Times and Gazette, 14th May 1870.

under the Professor's care. She was obliged to explain to him the cause of her abrupt departure, and to ask him to wait for payment of his services till she returned home. He not only intimated to her that he would accept no fee, but gave her in a present enough to pay her passage to New York.

His kindness was not confined to his patients. From persons who were entire strangers to him, and who were merely passing through Edinburgh, hospitality was never withheld. His breakfast and luncheon table was often crowded by foreigners, who, knowing the Professor no otherwise than by his world-wide reputation, and being told that he was extremely accessible, used to send in their cards, and received from him a cordial welcome.

Professor Simpson, in the spirit of true philanthropy, took much interest in the welfare of that wretched part of the population of Edinburgh occupying cellars, and frequenting haunts of vice in the Old Town. Many a time did he visit them at night, after his day duties were over. Moreover, he tried to interest others in their behalf, forming for that purpose, at his own house, parties of gentlemen and even ladies to accompany him. But the practice gave offence, and was discontinued.

Professor Simpson was imbued with strong religious feelings. Most persons here will probably remember how, in narrating the conversation which he had with Sir David Brewster on his death-bed, he was evidently pleased to be able to testify to the Christian faith of the dying philosopher. Simpson both lived and died a Christian; not only holding fast his trust in the Saviour, but desiring to impart the same comfort to others. His name may therefore well be added to those of Faraday and Brewster, who in our own day have shown that the highest attainments in philosophy and science, are not incompatible with strong religious feeling and the sincere faith of a Christian.

Professor Simpson was so remarkable in his outward appearance and expression, that any one, even happening to meet him in the street, could not fail to take special notice of him. Though short in stature, he had large features, and a shaggy head of unkempt hair. His eye was piercing, and his lips expressive. The energy of his physical constitution was wonderful, and he taxed it severely. Thus, after going to Oxford, to receive a University distinction,

he started next morning with two friends for Devizes, from whence he went on to Avebury to see "the standing stones," not getting back till midnight. On the following morning at five o'clock, he started for Stonehenge, and the same afternoon went to Bath to visit the Roman remains in that neighbourhood. On getting back at midnight, he found a telegram summoning him to a patient in Northumberland. He lay down for a few hours to sleep, and then went by the 4 A.M. train to London, and caught the Scotch "Express," which took him to Northumberland, from which place he went on to Edinburgh to resume his usual professional work.

What constitution could stand such incessant wear and tear? A severe attack of rheumatism followed the fatiguing journeys I have been describing, and this complaint continued frequently to torture him during the last two years of his life. Eventually the action of the heart became impaired, and *angina pectoris* supervened,—causing occasionally intense agony.

The fatigue and cold endured last February, in journeys made to London on the occasion of Lady Mordaunt's trial, brought on the illness which proved fatal. For two months he was confined to the house, and chiefly to bed, though even then he was able to write a letter on the subject of chloroform for publication in an American Medical Journal, the object of which was to refute some one who, in the previous number, had been endeavouring to dispute that he was the first to apply chloroform to anæsthetic purposes.

My sketch of Simpson's life, imperfect as it is, would be still more so, were I to omit notice of the distinctions which were showered upon him from almost every quarter of the globe. I cannot recount all the Academies, Universities, and Societies which bestowed their honours upon him. There was not one nation in Europe from which these honours did not come, and America joined in the general acclaim. Simpson was created a baronet of the United Kingdom. He received the knighthood of the Swedish Royal Order of St Olaf. He was made a laureate of the Imperial Institute of France; and the French Academy of Science bestowed on him what is called the "Monthyon Prize" of 2000 francs, given for any great discovery beneficial to humanity.

Gratifying to Simpson as these honours and distinctions no doubt were, there was one fact which must have been even more gratifying, and that was the introduction of chloroform, for medical purposes, in every civilized country, coupled with the almost universal acknowledgment that he had been the first to suggest and employ it for the relief of human suffering. He must also have felt that the world generally accorded to him the highest eminence in his profession, inasmuch as patients had come to him from every quarter of the globe, and as his works had been translated into every European language. Probably no man ever lived who, at the close of life, had the satisfaction of looking back on the same amount of work done for the benefit of his fellow creatures, and of possessing so largely their approbation and confidence.

In these circumstances, it is not surprising that, at the suggestion of the most eminent of the medical faculty in London, and warmly seconded by men there of high social position, a proposal was made, soon after Simpson's death had been announced, that his remains should be interred in Westminster Abbey,—that last resting-place of Britain's most illustrious sons. But the proposal was modestly, and I think properly declined by the surviving members of his family. Their decision was in this respect in accord with the unostentatious character and habits of the deceased. It was right and becoming that a man of his domestic dispositions should not be separated, even after death, from the other members of his own family, to whom he was deeply attached, but that he should lie beside them in the spot which he himself had selected, and where several had already been buried. Moreover, his interment at home allowed of an honour being conferred on him at his funeral, which, to my mind, was far greater than entombment in Westminster Abbey;—for his funeral was attended by all the public bodies and corporations of Edinburgh, and was thronged by thousands of sorrowing mourners, who, even from distant parts of the country, came to pay the last tribute of respect to one who had been so great a benefactor of the human race.

We have all to lament that our deceased friend and associate should have been cut off in the meridian of his fame, and whilst still running a career of usefulness. But we have reason to be thankful that his life, short if reckoned by years, was long, if

reckoned by good deeds and great services, not the least of which was the example he bequeathed of a man devoted to noble pursuits, characterised by incessant industry, imbued with benevolent dispositions, animated by Christian faith. In the letter already referred to, written on his death-bed, for the American Journal, he concluded it by saying, that he regarded the friendship of his medical brethren in America so highly, that he would not think this last effort at professional writing, altogether useless, if it tended to fix his memory in their love and esteem. It was to friends abroad, that this appeal was made. To friends at home, no such appeal was required. He knew that he had accomplished, what would for ever fix his memory in *their* love and esteem. To that sentiment, sure I am that his own countrymen and countrywomen cordially respond; and not less sure am I that the Fellows of this Society will ever remember with respect the eminent and diversified talents, as well as the signal services to science and humanity, of their distinguished associate.

James Syme was born 7th November 1799, and died 26th June 1870. Up to within a year of his death, he was Professor of Clinical Surgery in the University of Edinburgh, which chair he had held for thirty-six years. His father had originally followed the profession of a Writer to the Signet, but had retired at an early period with his family to the estate of Gartmore and Lochore in Fife. It is understood that, in consequence of there being no public school in the country which he could conveniently attend, Mr Syme obtained a tutor for his son whilst resident in Fife, so that he had in his early days no opportunity of associating with other boys,—a circumstance which may perhaps account for his shy and reserved manner in after life. Whilst a boy, it is said that he indicated a taste for anatomy, by frequently resorting to a butcher's shop, where he watched with interest the cutting up of sheep and oxen. His father at length seeing the necessity of giving to his son a better education and training than he was receiving in the country, sent him to Edinburgh to attend the High School. Afterwards, at the age of sixteen, he passed to the College, and became much interested in chemistry. When he returned during the holidays to Fife, he generally brought with him a supply of

apparatus—purchased with his own pocket-money—to enable him to carry on chemical experiments for his amusement.

So early as the year 1818 he had discovered a solvent for caoutchouc in the naphtha obtained by distillation from coal-tar, and in March of that year addressed a letter describing his discovery to Dr Thomson, then editor of the "Annals of Philosophy," which appeared in that publication in August following. Mr Syme in this letter states that "he had, by means of the discovery, waterproofed a *silk cloak*, so that it afforded complete protection from the heaviest rain, and could be employed as a pitcher by turning up its skirt." He adds that he had "constructed flexible tubes of the same substance." It appears that he had worked at this subject for two years before the discovery. The discovery was deemed so important, that Dr Thomson and some of his friends recommended young Syme to take out a patent, assuring him that it would make his fortune. But by this time he had determined on following the medical profession, which he thought more respectable than that of a manufacturer. He therefore contented himself with publishing his discovery, and receiving general commendation for his disinterestedness. Not long afterwards the discovery was turned to good account, as we all know, by Mr Macintosh of Glasgow, who made a large fortune by means of it, and who gave his name to the cloth, though in reality invented by Syme.

Syme became a pupil of Dr Barclay in order to study anatomy; and in 1818 he went into Liston's dissecting-rooms, as his assistant. He was a distant cousin of Liston's.

In 1820 he obtained the appointment of Medical Superintendent of the Fever Hospital,—an appointment entailing much personal risk, as Mr Syme soon discovered; for he caught the infection, and nearly died.

In 1821 he became one of the dressers in the Edinburgh Royal Infirmary. As such, it was his duty to carry out the instructions of the acting surgeon. In this position he showed the possession of considerable courage and self-reliance, by disobeying some instructions which his judgment condemned. The system of blood-letting was then in full operation, and every evening at a certain hour, the dressers had to bleed the patients whose names were entered in a book, and take from each the number of ounces of

blood there specified. On one occasion Syme had to take from a patient in one of his wards so much as 65 ounces, to be followed next day by other 35 ounces. Another patient was a boy, one of whose legs had a compound fracture, which gave rise to profuse suppuration. About three weeks after the injury, the boy's strength being much exhausted, Syme took it upon him to order porter and a beef-steak. Next day the acting surgeon, then one of the most largely employed medical men in Edinburgh, expressed disapproval of this regime, as he said it would feed the disease, and directed Syme to take 14 ounces of blood from the boy's arm. Syme obeyed with reluctance, and not without remonstrating. Before the end of forty-eight hours, the boy was dead.

In 1821 Syme was elected a member of the Royal College of Surgeons of London, and in 1823 a Fellow of the Edinburgh College of Surgeons. About the same time he went abroad to Germany and France, visiting different hospitals, and forming useful acquaintances. He also entered into a sort of partnership with Mr Liston, and occasionally took Liston's place in the lecture-room. This partnership, however, did not continue long. A quarrel occurred, which caused an estrangement of many years' duration.

But Syme, notwithstanding that he thereby lost an advantageous position, was not discouraged. He entered into another partnership with Dr Macintosh (who then lectured on midwifery and the practice of medicine), for the purpose of establishing a new medical school, with an anatomical theatre, dissecting-rooms, and museums,—he himself intending to lecture on anatomy and surgery. The very boldness of the undertaking arrested public attention. The school, however, failed; but Syme himself, fortunately by zeal, talent, and complete knowledge of his subject, coupled with an indication of views which were innovations on established practice, soon attracted a large number of students. His chief difficulty arose from the scarcity of subjects for dissection, except by dealing with the "Resurrection-men," as they were profanely called,—a course which Syme detested. In order to pursue his anatomical researches, he took advantage of the holidays to go over to Dublin. When there, he made acquaintance with several eminent surgeons, and was so delighted with their modes of operation—which he thought superior to those of Edinburgh—

that he resolved to abandon anatomy, and confine his teachings to surgery.

In 1829 he had as many as 250 pupils attending his surgical lectures, a success the more remarkable, considering that Liston, Lizars, and Turner, were rival lecturers. This well-attended class he kept up for several years.

Syme had been most anxious to get on the surgical staff of the Royal Infirmary. But Liston was one of the surgeons; and the managers knowing the animosity which existed between him and Mr Syme, felt that by admitting both into their institution, there would be every probability of dispeace. They refused Syme's application. He therefore resolved to set up a rival institution, and took Minto House, with 15 rooms in it. These he converted into wards. He also formed an out-patient department. This was a still bolder exploit than any before ventured on, but it was rewarded with complete success. On the very first day that the new hospital was opened several patients sought admission, and in the next two days as many as ten young medical men applied for the house surgeoncy, though £100 was required as a fee. The report for the first year tells of 265 in-door cases, 1900 out-door cases, and 95 operations. For four years this new institution was carried on, with unvarying success, vieing with the old established Royal Infirmary in the number and importance of its operations, and presenting a striking proof of what could be done by one young man, not only unsupported by local influence, but overcoming local and social influence arrayed against him, by dint of indomitable zeal, natural talents, and great professional knowledge.

Syme's seminary for instruction in Clinical Surgery, was recognised by the College of Surgeons in London, as qualified to give instruction for medical students. The Edinburgh College of Surgeons refused to recognise the new hospital, but agreed to recognise a course of lectures on Clinical Surgery, if Syme chose to give them, on the condition, however, that the pupils attending these lectures did not exceed 40 in number, and that they paid the same fees as were received by Mr Russell, the Professor of Clinical Surgery in the University. To these terms Syme acceded; and by his admirable lectures soon laid the foundation of subsequent brilliant reputation as a clinical teacher.

It was during this period, when he was an extra-academical lecturer, that he published two books, one "A Treatise on Excision of Diseased Joints;" the other "The Principles of Surgery." These books, which embraced numerous cases of successful operations by the author,—many of them indicating new and improved practices, extended Syme's fame over Europe, and paved the way for another distinction. This was his appointment to the Chair of Clinical Surgery in the University of Edinburgh, which Mr Russell (now in his 83d year) resigned. It was obtained in spite of the opposition of his former master and jealous rival, Liston, who wished it for himself, but would not accede to the conditions required by the Patron, the Crown, that Mr Russell should have from his successor £300 a year of retiring pension. Mr Liston had, up to this time, succeeded in shutting Syme out from access to the Infirmary. That exclusion, however, the managers saw could scarcely be continued after Syme had become Clinical Professor in the University. It was a fortunate event for both parties that, about this time, an invitation came to Liston to remove to London to become Professor of Clinical Surgery in University College, an invitation which he gladly accepted. Shortly after this event Liston wrote to Syme expressing a wish to be reconciled—a wish to which the latter readily acceded.

Liston died in 1847, and Syme was then invited to succeed him as Clinical Professor in University College, London. Syme felt flattered by the proposal, and was pleased at the prospect of going to a capital where private practice would be far greater and more remunerative. He was, however, exchanging a certainty for an uncertainty. He had L.700 a-year from his class in Edinburgh, and full employment as consulting surgeon, whereas all that was offered to be ensured to him in London was a fixed salary of L.150 independently of class fees. Nevertheless he resolved on throwing up his position in Edinburgh, where he commanded both respect and emoluments, and in February 1848 repaired to London. He soon found that he had taken a wrong step. His class was less numerous, and though his practice might eventually become great, he felt that it would be long before that pecuniary advantage was arrived at, and perhaps still longer before he could attain the social position which he held in Edinburgh. His manner was also rather

reserved for acceptance in London society. Hence, though he was making rapid progress in surgical practice, he soon began to wish he had never left Scotland. It was when in this mood that he received a request from the council of the London University to deliver lectures on systematic as well as on clinical surgery. Thereupon he at once sent in his resignation. In fact, before leaving Edinburgh he had stipulated that he should be exempted from this additional duty. The month of July 1848 found him back again in Edinburgh, after only a four months' stay in London, during which time, however, he had succeeded in acquiring the entire confidence and esteem of the medical students; insomuch that, when they heard of his intention to leave them, a committee of their number waited upon him, beseeching him to remain, and saying that an address was about to be presented, signed by every individual student. But he declined the entreaty, flattering though it was. He felt he had made a mistake when he left Edinburgh, and he was resolved to correct it before it was too late. Fortunately for Syme, the Chair of Clinical Surgery in the Edinburgh University, vacated by his going to London, had not been filled up. He was again appointed to it, and his return to the scene of his former success was greeted by general acclamation alike from students and old friends.

In subsequent years Professor Syme, besides teaching his class and attending the Infirmary, took part in the proceedings of various medical and scientific societies. He became President of the Edinburgh Medico-Chirurgical Society in 1848. He had previously become a Fellow of our own Society, and communicated to it a very important discovery, that the formation of bone is due to the Periosteum—a discovery which was the subject of a paper published in our Transactions. The importance of this discovery is great, as it often renders amputation of a limb unnecessary, in the case of diseased bones, if the disease be not in the periosteum.

At a later period, Mr Syme's active mind led him to pay attention to subjects of more general interest connected with the medical profession. In the year 1854 he took up the question of medical reform, and addressed a letter to Lord Palmerston and Lord Elcho, recommending the appointment of a General Council to

pass regulations for the granting of medical licenses in the United Kingdom. He continued for several years to take part in the public discussion of this question. His views were very generally approved of, and, I believe, formed the basis of much of the Legislation which has since taken place.

Another subject of much local interest in Edinburgh, which engaged Professor Syme's attention, was the best site for a new Infirmary. At first he advocated the old site; but, on farther consideration, he confessed he was in error, and ultimately energetically assisted those who wished the new hospital to be built in the suburbs of the town, where purer air for the patients would be secured.

During the winter of 1868–9 Mr Syme's health was not what it had been. He was less able for the fatigues of lecturing. He was also much harassed by the frequent meetings he had to attend about the new Infirmary, and he was greatly annoyed and irritated by a disagreeable professional controversy in which he was involved. The spring of 1869 also brought heavy domestic affliction. On the 6th April, after performing an operation in the Infirmary, he had a bad attack of paralysis, which, however, left his mind unclouded. He so far recovered that he was able once or twice to walk from his villa of Millbank to see patients in his consulting rooms in Edinburgh, and even to give advice in the Infirmary as a consulting surgeon. He resigned his chair in July 1869. In the spring of 1870 he still continued to see patients, but another worse attack of paralysis occurred in May, and he died on the 26th of June. He was interred in St John's Episcopal Church, of which he had long been a member, followed to the grave by very many of his old friends and pupils.

I will of course not attempt any account of the services rendered by Professor Syme to the special branch of the medical art to which he attached himself. All authorities concur in saying that, in virtue of the many important discoveries made by him, his skill as an operator, his diagnostic sagacity, and his accurate teaching, he was the greatest surgeon of his time. His services were twofold. He abolished, or assisted to abolish, many bad practices in surgery, and he was the means of introducing many new practices which have been generally adopted. Among this

last class may be mentioned his diminishing the frequency of *amputations*, and substituting *excision* instead, whereby many a person now retains an arm or a leg, which surgeons previously had been in the habit of cutting off. The like good effect followed from his discovery, that the formation of bone was due to the periosteum. His treatment of aneurisms was very successful. He had an almost instinctive faculty in discerning the true character of tumours, of which one example, not generally known, may be mentioned. A Scotch nobleman was suffering from polypus in the nose. He had consulted the most eminent surgeons in Paris and London. In both of these capitals he received the same opinion, that the tumour being of the malignant type, it could not be extracted with any probability of saving life. Some of this nobleman's friends suggested a visit to Edinburgh, to obtain Professor Syme's opinion. He accordingly came here, and a consultation took place. Mr Syme thought the tumour not malignant, and he gave an opinion that it might be radically extirpated. The operation was performed, and with complete success. The nobleman alluded to is now alive, and in good health.

Syme's manner was reserved and sometimes abrupt to his patients, of which the following anecdote, related to me the other day by a medical friend, is an illustration. A landed proprietor in Northumberland had been thrown out of his dog-cart, and was so severely bruised that he feared his shoulder had been dislocated. His medical attendant had a doubt about it. He therefore resolved to go at once to Edinburgh that Syme might see it. At the hour appointed he called on Syme, and was shown into a room where the Professor was standing before the fire. As the gentleman advanced, Syme bowed stiffly, but did not speak. The gentleman, who was lame from gout,—as he hobbled into the room, by way of beginning conversation, intimated that he was very gouty, on which Syme said, "If that 's all that 's the matter with you, you need not come to me; I don't cure gout." The gentleman next said, "But I think my shoulder is dislocated, and I want you to examine it, if you will help me off with my coat." Syme replied, "I need do nothing of the kind;—your shoulder is not dislocated. Take my word for that. I don't need to see it." The decided tone in which Syme spoke, so impressed the old gentleman that

he obeyed, and bid Mr Syme good morning, but not before giving him a double fee for his welcome opinion. He told his medical man, when he returned home, that he thought Mr Syme the most self-possessed man he had met with, and would assuredly go back to him if he ever had again to consult a surgeon.

Syme was remarkable not only for self-possession, but for the more noble qualities of professional sincerity and honesty. When he found himself in the wrong, he never hesitated to alter his course, nor was he ashamed to confess it. When the late Sir David Baird of Newbyth was severely hurt by a kick from a horse in Berwickshire, Dr Turnbull of Coldstream, who attended him, becoming somewhat anxious, brought Mr Syme out to see him. Mr Syme, after inspecting the broken leg, and considering the case, gave a decided opinion that there was no reasonable ground of apprehension, and returned to Edinburgh the same day. But that night Sir David Baird became restless and feverish, and Dr Turnbull, notwithstanding Syme's opinion, on the following morning thought of again sending for Syme. Early that forenoon he was surprised to see a carriage drive up to the door, and to find that Syme was in it. Dr Turnbull expressed his happiness at seeing him so soon again, but asked what had brought him back; on which Syme said, "I never closed my eyes last night, because I began to fear I had given you a wrong opinion, and I have come back to see your patient again." Syme, after another examination, satisfied himself that there was too good reason for anxiety, and intimated that he thought Sir David Baird would not recover. He died two days afterwards.

Syme, though he published very many papers in the medical journals, was not a voluminous writer. As in his operations he got through his work quickly, never drawing from his patient an unnecessary drop of blood, so in his publications he wrote concisely, and seldom wasted a drop of ink on illustration. His most important work, "The Principles of Surgery," went through five editions, the last edition being in bulk smaller than any of its predecessors. His aim, both in his books and in his lectures, seemed always to be, to give a maximum of instruction in a minimum of words.

Syme was proud of his profession, and proud of his own posi-

tion at the head of it. Perhaps it was from this cause that he was charged with unwillingness to admit and adopt the improvements suggested by others in surgical practice. On the other hand, he was quite indifferent about pressing his claims to any honorary distinction. Nevertheless, from various public bodies, he did receive, unasked for, acknowledgments of his merit; as when there was conferred the M.D. degree from the Universities of Dublin and of Bonn, the D.C.L. degree from Oxford, and the Knighthood of the Dannebrog from the King of Denmark, an honour rarely granted to a foreigner. On a General Medical Council for the United Kingdom being appointed, he was chosen a member of it, to represent the Universities of Edinburgh and Aberdeen. For ten years he took a lively interest in its proceedings, and his opinion was always listened to with respect. It was probable that Syme would have been elected President of the General Medical Council on the retirement of Dr Burrows in 1869, but Mr Syme about this time became unwell, and his friends saw he would be unable to fulfil the duties of the office.

After Syme resigned his professorship in July 1869, a movement among his professional brethren, who knew his merits as a surgeon, was commenced, for the purpose of raising a testimonial which might keep his name before future generations. It was all the more striking and gratifying that this movement commenced in London, and was warmly supported in America, because indicating the judgment of those who could estimate his services free from the influence of local feelings. The testimonial will embrace a scholarship to bear Syme's name of L.100 a year for students of surgery in Edinburgh University, and a marble bust of Mr Syme for the great hall of the library. The funds for the testimonial have been nearly all subscribed. Should there be any deficiency, I understand it will be made up by the University Endowment Association.

Besides testimonies from abroad to his professional services, several from his countrymen in Scotland, of a very gratifying kind, were not wanting. From many provincial associations of medical men, there came addresses expressing regret that he should have found it necessary to resign his professorship, and conveying to him the respect and gratitude of those who had benefited by

his advice, teaching, and example. One of those addresses, from the Border Medical Association, dated at Kelso, on the 18th August 1869, runs as follows:—

"At the twenty-third annual meeting of the Border Medical Association, we, the undersigned members, unanimously resolved to ask you to receive from us a short address on the occasion of your resignation of the Professorship of Clinical Surgery in the University of Edinburgh.

"We desire to convey to you our warmest thanks for the very kind manner in which you have at all times discharged your duties towards our patients and ourselves. We beg also to thank you sincerely for innumerable acts of personal kindness and attention, for which we shall ever feel grateful. Although the members of our profession generally have resolved to offer you some testimonial in recognition of your inestimable services, and although you have already received a most hearty expression of sympathy and regard from the profession practising in far distant lands, we trust that it will not be otherwise than agreeable to you to know that the medical and surgical practitioners in your own Border-land are equally sensible of and grateful for the great advantages they have derived from your precepts and example. It was with unmingled feelings of sorrow and regret that we heard of your illness, and we now most heartily rejoice to know that you have so far recovered as to be able, in some degree, to resume those professional duties which we have all learned to value so highly. We desire to express the earnest hope that you may yet be long spared to give us the benefit of that eminent wisdom, vast knowledge, and matchless diagnostic tact and skill which have rendered your name famous wherever the science and art of surgery are known. It is to us a source of pleasure that, on the very day of our assembling here, it has become known that you are to be succeeded in your chair by your son-in-law, Mr Lister, believing as we do that his appointment will be peculiarly gratifying to yourself, in the highest degree acceptable to the profession at home and abroad, and highly calculated to maintain the celebrity of the Edinburgh surgical school, in which you have so long been the distinguished master."

If there was any taste or pursuit beyond that of his own special profession for which Mr Syme had a predilection, it was gardening. He long cultivated with great success the rarest plants of distant temperate and tropical countries, and annually carried off the highest prizes at the exhibitions of the Horticultural Society of Scotland. He was equally successful with tropical fruits, among others the banana, which he was one of the first in this country to ripen in perfection. In his later years, at his villa of Millbank, he formed a large collection of Orchids. Among these he spent much of his leisure hours. To his friends and former pupils, when they came to see him, he was ever ready to show kindness and hospitality; and the friendships which he made were lasting, warm-hearted, and disinterested.

Perhaps the leading qualities of Syme's character, and which ensured his success in life, were clearness of perception, fearless honesty of purpose, and strength of will. He was always able to see clearly the point at which to aim, and by steadiness both of eye and hand, to reach it, in spite of obstacles and difficulties which would have made most other men flinch. Self-reliance was *his* chief stepping-stone to fame,—the honourable fame of having greatly advanced the science which tends to save life and limb, and also to assuage human suffering.

III. I come now to the third head, which *is to offer a few suggestions for increasing the efficiency of our Society.*

Under this head there are two points which demand attention.

1*st.* Can our present arrangements be improved?

2*d.* Are there any drawbacks which can be counteracted?

(1.) In regard to our present arrangements for carrying on the Society's business, the most important is undoubtedly the publication of papers in our Proceedings and Transactions. Its importance cannot well be over-estimated. Probably but for this mode of recording discoveries, speculations, and inventions, and also of publishing them, half of these would never have become known to the world. It is no disparagement to the papers which appear in our Proceedings and Transactions to say of them, that to only one person out of a thousand are they of any interest, and therefore that they would not be read, and would not pay to be published by the authors at their own expense. But next to the pleasure of effecting discovery, is that of making known the discovery to others. This last pleasure can therefore in many cases be obtained only through means of societies like ours. But there is another and a separate good done: not only are investigators stimulated, but when the results of their investigations become widely known, these often suggest new views to other inquirers, who make use of these published results as stepping-stones for overcoming some difficulty which had obstructed their own inquiries. In that way, also, men of science and literature in different countries become acquainted, so as to aid one another in their respective labours.

I have surely said enough to show how useful these publications

are, and it is no small proof of this when we find, as I have already stated, that our Transactions are almost every year becoming more bulky.

The only practical suggestion which it occurs to me to offer under this head is, that means should be taken to ensure early publication. I am sorry to find that the volume containing last year's papers has not yet been published, though the Society's law expressly states that "the Transactions shall be *published at the close* of each Session."

(2.) Another part of our proceedings to which I respectfully invite attention is the best mode of conducting our evening meetings. What is the object and use of these meetings? From a paper published in the first volume of our Transactions, entitled, "*History of the Society*," drawn up, I believe, by the first secretary, Dr Robison, it is stated that these meetings were held in order that—

"Essays and observations of members or their correspondents may be read publicly, and become the *subjects* of *conversation*. The author is likewise to furnish an abstract of his dissertation, to be read at the next meeting, when the *conversation* is renewed with increased advantage.

"Several papers have been communicated with the sole view of furnishing an occasional *entertainment* to members, which do not afterwards appear in the Transactions. Essays and cases are often read at the meetings in order to obtain *the opinions* of members on interesting or intricate subjects. Some papers intended for future publication have been withdrawn for the present by their authors, in order to profit by what has occurred in the *conversations* which the reading of the papers has suggested."

The original intention, therefore, of our evening meetings was to encourage discussion among the members on the papers read, and this object we have ever since kept in view, though on account of the length and number of the papers put down to be read in one evening, there has often been no time for any discussion of them.

I suppose it had been with the view of remedying this inconvenience that in October 1836 the Council of the Society made a remit to the three secretaries—

"To report as to the possibility of economising time by some change in the present order of the business of the general meetings, and by inducing the authors of papers to give (when necessary) condensed abstracts of them, leaving the details for being printed when their publication in the Transactions may be determined on."

The three secretaries accordingly, in December 1836, reported how this object might be brought about, viz., that

"The members of Council to whom papers are referred for preliminary examination shall, after perusal, *advise with the authors* in what manner they may be *shortened* in reading them to the Society. The secretaries farther submit, that some course of this kind is imperiously called for, by the increasing number and value of the communications presented to the Society. They farther express their conviction, that the change in question, if acted on by authors, will add greatly to the spirit of the Society's meetings, and to the interest of the members in its proceedings."

They add in their report, "That the public business, if time enough be left, should be concluded with verbal communications of scientific news."

This report was adopted and approved of by the Council, and ordered to be printed, so that I have no doubt it was communicated to the Society generally, and attempted to be carried out.

In now therefore bespeaking renewed attention to this subject, I only desire to urge what seems to have been alike intended by the founders of the Society, and aimed at by those who have preceded us in the Society's management.

The advantages of a good attendance of members at our meetings, and also of a discussion of the papers read at them, are obvious. It is for the credit of the Society, that its members should take an interest in its objects, and show that interest by attending its meetings. It is an encouragement to literary and scientific authors to bring forward papers, when they know that these will be read, not to dead benches, but to living associates, and to associates who will listen, and some of whom will state, after hearing the papers, whether they appreciate the views contained in them. It is also an advantage to members to have an opportunity of meeting one another, for the purpose of cultivating friendly intercourse, and obtaining information.

In the Geological Society of London—the only Society there, whose meetings I have had an opportunity of attending—special means are taken to induce a good attendance, and also to induce verbal *discussion* at evening meetings. As papers are more intelligible and attractive when illustrated by diagrams, authors of papers are encouraged to exhibit diagrams whenever that is possible, the Society paying the cost of them, subject to certain

checks. Discussion almost invariably takes place; though whether any previous arrangement to ensure this is made, I cannot tell. After the public business is over, there is an adjournment to an adjoining apartment for refreshments; in which apartment there are comfortable chairs and sofas, where members and their friends can chat together if they like. There is also at these meetings a greater variety of refreshments than we provide.

I trust I may be excused for referring to these common-place details, but I attach so much importance to a good attendance at our evening meetings, that I would desire to leave no means untried to secure it.

What are the means which, for this purpose, I suggest?

1*st*, I think that papers of so abstruse a nature as not to be intelligible to three-fourths of the members, ought not to be read, nor even an abstract of them,—but only a verbal account given of the nature of the paper, and its bearings.

2*d*, No paper, however intelligible, should be read *verbatim*, unless it occupy only a few minutes, say fifteen or twenty, but only an abstract of it shall be read or verbally stated.

3*d*, The members of Council to whom the paper has been referred to report on its fitness for the Society should be prepared, after the author has read his paper or stated its substance, to give their opinion of the merits of the paper, the President for the night also adding a few remarks.

4*th*, Diagrams, where possible, ought to be exhibited, one-half of the cost of which should be paid from the Society's funds, subject to the check of a committee.

5*th*, It shall be competent for a Fellow at the commencement of business, with the leave of the Secretary and President for the night, to exhibit any article or object, organic or inorganic, or any instrument of scientific interest recently discovered or invented, and give a short verbal explanation, it being understood that such verbal explanations shall be concluded before 8.15 P.M., so that the written papers announced in the billet may then be proceeded with.

6*th*, There ought to be in the retiring-room something better provided, in the way of refreshment, than a cup of tea, as also chairs or sofas for the convenience of those who attend the meetings.

2. The next point to which I advert is the existence of certain

drawbacks to the efficiency and influence of our Society, and the possibility of counteracting these.

When our Royal Society was established, now nearly ninety years ago, no other society devoted to literature or to science existed in Edinburgh. It was therefore natural and right that the Society should embrace, among its objects, all the departments of knowledge which were then known, or were beginning to be cultivated.

The rapid extension of different sciences soon rendered it impossible for one society to give due attention to all these, or to assist investigators in each, to the full extent that they desired.

Hence separate societies came to be formed, devoted to particular sciences; and these societies were naturally joined by many persons who, but for them, would have probably become members of our Royal Society.

What has been the consequence? We have in Edinburgh, and our other large towns, very many institutions, both literary and scientific, which are strong in membership; and even in our provinces, we have societies and clubs, devoted to botany, geology, zoology, and archæology, some of which also possess a large staff of members.

Let me enumerate the membership of some of the Edinburgh societies:—

| | | |
|---|---|---|
| The Medico-Chirurgical Society, instituted 1821, has about . . . . . | 300 | Members. |
| The Philosophical Institution, about . . | 2000 | „ |
| The Geological Society, instituted in 1834, has | 180 | Ordinary Members. |
| The Royal Physical Society, . . . . | 250 | „ „ |
| The Botanical Society, instituted 1836, . . | 360 | „ „ |
| The Arboricultural Society, . . . . | 500 | „ „ |
| The Society of Antiquaries, . . . . | 300 | „ „ |
| The Royal Society of Arts, instituted 1821, has | 420 | „ „ |
| The Meteorological Society, instituted 1856, . | 600 | „ „ |

With regard to provincial societies, I may mention that Sir Walter Elliot* of Wolfelee has lately been making out a list of Natural History Societies and Field Clubs, existing not

* The list here referred to will be found in an address delivered by Sir Walter Elliot to the Botanical Society of Edinburgh on 10th November 1870; and is to be printed in that Society's Transactions for 1870–71.

only in Scotland, but in England and Ireland. This list will be exceedingly instructive, as I understand it specifies the objects of each Society or Club, the nature of its operations, and the district of country with which it is connected. He has had the kindness to send to me an account of twelve of these provincial societies, the most northern being in Orkney and Shetland, the most southern in Berwickshire, Dumfries, and Galloway. About one-half of these societies publish proceedings or reports in some form or other, for circulation among their own members. To one of these last-mentioned provincial societies, connected with the Eastern Borders of England and Scotland, "The Berwickshire Naturalists' Club," Sir Walter Elliot and I belong. It has a membership of 250 persons, and has published six octavo volumes of reports on topics—Botanical, Geological, Zoological, Entomological, and Archæological.

Though it is chiefly the Edinburgh societies which keep members from our Royal Society Roll, and papers from our Transactions, there can be no doubt that the societies of other towns, and of the provinces, act more or less in the same direction. But in saying this of any of these separate societies, I mean no disparagement of them; nor, in spite of their interference with our usefulness and influence, do I regret their multiplication. On the principle of the division of labour, the more societies the better, for the sake of the stimulus they give to scientific investigations. The late Principal Forbes, in his address from this chair in the year 1862, in alluding to the effect which these societies had on us, thought that they "fostered (to use his own words) a *spirit of rivalry* towards the larger, more national, and more permanent Institution, which the Royal Society of Edinburgh might fairly claim to be." I have never seen indications of a spirit of rivalry, in the sense of hostility. All the length I can go is to admit—as, indeed, I affirm—that the existence of so many separate scientific societies in Scotland has the effect of curtailing our membership and our operations, and that this effect will increase unless means be devised to counteract it.

I think such means may be devised, and with advantage, not only to our own and other societies, but to the cause of science. There are many researches and inquiries which can be pro-

secuted successfully only by the co-operation of many persons acting together, or acting in different districts. Opportunity for such co-operation might be afforded by separate societies. Thus the Committee of the British Association on Luminous Meteors lately applied to the Scottish Meteorological Society to have a certain number of their observers, situated in different parts of the country, told off to watch on particular nights the occurrence of meteors, and mark down on maps furnished to them their positions, the direction of their movements, and other particulars. That is an example of two independent scientific bodies co-operating together. What I next mention shows the co-operation of six or eight societies. In Switzerland, and in the South of France, the various Natural History and Physical Societies have been carrying on a joint investigation to record the exact position of the most remarkable "boulders" in the districts with which they are severally connected. For this purpose one central society—the Helvetic Society—has issued to the societies at Neufchatel, Berne, Aargau, Geneva, Lyons, and Grenoble, suitable maps and schedules. These societies have already made great advances in ascertaining and marking down the exact position of numerous boulders above 100 tons in weight. They have done more, for they have succeeded in stopping the wholesale destruction of boulders, which were being victimised to agricultural improvements; and so much have their objects been appreciated by the municipal and State authorities, that the latter pay the cost of the necessary printing, and other expenses required for the investigation.*

Another case of co-operation nearer home may be mentioned. Professor Roscoe of Manchester is forming what he calls a "National Science Union," embracing not only scientific investigations, but also, and even more especially, action on the Legislature and the Government. With reference to this last object, he observes, that "although those who are engaged in scientific investigation or instruction, undoubtedly form one of the most intelligent professions in the kingdom; yet, for want of union,

* Professor Faure of Geneva has had the kindness to send to me several of the Maps, Schedules, and Reports, showing the progress made by the different societies aiding in this investigation.

they have no commensurate influence on the Legislature. The interests of commerce, manufactures, agriculture, railways, and the clerical, legal, naval, and military professions are represented by strong parties in Parliament, yet there are very few members of either House who can be said to represent the high interests of science. It is therefore urged that no time should be lost in creating an organisation, which will enable those interested in the progress of science to use their proper influence, and when the time arrives, to press their legitimate claims upon the Legislature." A programme has been widely circulated for the purpose of ascertaining how far the proposals contained in it meet with the support of men cultivating all branches of science, and living in all parts of the country. Professor Roscoe adds, that "the present moment appears to be well suited for action in this matter, as the establishment of a union amongst men of science must strengthen the hands of the Royal Commission now considering the whole subject of State aid to science."

The movement thus commenced, and going on in various quarters for co-operation and confederation, deserves our consideration. We see the important purposes which may be thereby attained, not only by facilitating important physical investigations, but also by giving to scientific bodies a greater power and influence in the country to which they are well entitled.

If it be asked how co-operation and confederation can best be secured, I may perhaps be told that it will be enough to trust to sympathy with each other, created by the pursuit of common objects, and that no special or formal alliance is necessary. As among all the branches of human knowledge relationship prevails, so it is said there is naturally and unavoidably a similar connection among societies. But the well-known Roman aphorism which speaks of this relationship, speaks also of a bond to cement it, "Omnes artes quae ad humanitatem pertinent, habent commune vinculum, et quasi cognatione quadem inter se continentur." The "commune vinculum" here referred to, is, I think, desirable; and that bond may fitly be constituted by a central society, which, embracing in its own programme of operations various sciences, holds out a hand of welcome and co-operation to other societies, severally devoted to some one of these sciences. The

late Principal Forbes strongly maintained the expediency of a central society on a separate ground, which is explained in the following paragraphs of his address. He urged that—

> "To maintain the character for energy and stability of one central society, is in reality the common interest of all who cultivate science. Delightful and instructive meetings may be held by a local body of geologists, or chemists, or naturalists. But such local associations require immense vitality to be permanent. Generally they fall into abeyance in twenty or thirty years; and if they attempt to record their labours by publications, these publications having never attained more than a very limited circulation, become inaccessible and forgotten. The matured written reports of these labours in minor societies, are best consigned for preservation to the publications of a central and enduring association."

All these views evidently point to our own Society, as being one well qualified to undertake the duties and position of a central body in order to promote co-operation and confederation among the various scientific bodies in Scotland; and if it be objected that my views could not be carried out without some considerable change in our established customs, I have only to say, that as in Governments, it is wise to make from time to time such reforms as are called for, in order to retain public confidence, or promote more efficient action; so in other institutions, it is equally expedient to watch the progress of events, which may necessitate from time to time some changes in their modes of operation.

The changes, however, which would benefit both our own Society and others, are really not so important, as that the Council of its own authority may not competently adopt them. They are as follows:—

(1*st*.) That should any society in Scotland having literary or scientific objects, desire to be connected with the Royal Society of Edinburgh, it shall, if our Council approves, be held to be affiliated with us, and to be entitled to the privileges of an affiliated society.

(2*d*.) That any member of an affiliated society, on intimating to our secretary his name and address, shall receive a billet, entitling him to free access to our meetings, as well as to our library and reading-room.

(3*d*.) That an affiliated society shall have right to send to us, through its office-bearers, reports or papers by any of its members, on literary or scientific subjects, which if approved by the Council,

may be read at our evening meetings, and may be published in our Transactions.

(*4th.*) That our Council, on the other hand, shall be entitled to appeal to any affiliated society for co-operation in the ascertainment of facts, or the investigation of phenomena, lying within the compass of its objects, and also within the field of its operations; and if, in response to this appeal, a report is made, we may, if approved by the Council, have it read or noticed at our meetings, and published in our Transactions.

(*5th.*) That in the event of any important investigations or experiments being wished to be made by the members of an affiliated society, which however cannot be made by them on account of the expense thereof, it shall be competent for the office-bearers of such affiliated society to apply to the Council of our Society to defray a portion of the expense, out of the funds of our Society, or out of an annual grant, should such be obtained from Government, to aid scientific investigations in Scotland.

Some such arrangements as those I have now suggested, would probably produce co-operation among most of the societies in Scotland devoted to science or literature, a co-operation which would be attended by advantages, both to them and to the advancement of their objects.

IV. In adverting, under the next head of this address, *to the usefulness of such societies as ours*, it is only necessary to observe that they have been established to aid philosophers in the peculiar work to which they devote themselves. Whether we regard the work they accomplish, or the motives which inspire them, these philosophers deserve all the encouragement and aid which can be given. They love knowledge for its own sake;—their chief pleasure consists in searching for knowledge;—and their highest happiness is to discover some new truth. Fortunately for the world, there have been in all ages, and among almost every people, individuals who have cherished those noble aspirations. The old Hebrew king has recorded, how he "applied his heart to know and seek out the reasons of things," and avouched from experience, how "Happy is the man who findeth wisdom." The enlightened Roman expressed the same sentiment when he exclaimed, "Felix

qui potuit rerum cognoscere causas." The Greek mathematician, on discovering that the square of the hypothenuse in a right-angled triangle is equal to the sum of the squares of the other two sides, in testimony of his happiness offered a hecatomb to the gods; whilst a Sicilian philosopher, when he found how to ascertain the specific gravity of bodies, was so overjoyed, that he rushed out of his bath naked into the streets, mad with delight. Our own Sir Isaac Newton became so elated or agitated when approaching the end of his calculations, which he saw would prove that the planetary movements were all governed by the law of gravitation,—that law which he was the first to discover,—that he was obliged to hand over his calculations to a friend to complete them. These men, and thousands more of the same stamp, were all animated by a heaven-born instinct to pry into the mysteries of nature, to study the mechanism of the universe, and deduce the rules or principles which the Almighty had followed in the work of creation, and still follows in the equally great work of upholding the universe. Their tastes were noble, because pure; their researches and labours also were noble, because disinterested. They worked not for their own individual benefit, nor even for that of their own kin or country, but for that of the human race. Men characterised by such tastes, such motives, and such pursuits, surely deserve encouragement, and if scientific societies afford it—their usefulness is unquestionable.

How these societies afford this encouragement I have already partly explained, when adverting to our own operations, and in particular to the stimulus given to men of science, when by means of our meetings, and our Transactions, they obtain an opportunity of intimating their discoveries and publishing them. It is probable that there are thousands of discoveries—the groundwork of important inventions,—which never would have become known,—nay, which never would have been made, but for the existence of such societies as ours. For example, the Principia of Newton would not have been given to the world at the time they were given, had the Royal Society of London not agreed to print them; for Newton was so poor, that he could not afford to continue his subscription as a member of the Society, small as that was.

Whilst philosophers are encouraged by these societies to investigate, by knowing that their discoveries will be recorded and published by the societies of which they are members, others who may or may not be members, when they see these discoveries and study their bearings, are often able to turn them to account, and in a way never anticipated by the authors. Hundreds of cases can be stated, where papers published in scientific transactions, on being perused and studied by other inquirers often in a distant part of the world, have been to them as bridges, enabling them to pass over difficulties which previously had obstructed progress, and on the brink of which they had been sitting in despair.

That scientific societies contribute immensely to the advancement of knowledge, may be farther inferred from this circumstance, that as it is during the last fifty years that discoveries and inventions have been more plentiful than in any former age, so it is during the last fifty years that these societies have multiplied, and a wide circulation given to their published transactions.

To these societies mainly, mankind is therefore indebted for the marvellous contrivances and processes which distinguish the present age above all that have preceded it. Most of these—such as electro-magnetism, electro-plating, photography, artificial light, improved telescopes and microscopes, steam machinery, anæsthetical agents and medical disinfectants—sprung out of experiments, observations, or speculations, were very unpromising as regarded any practical utility when first announced, but ultimately became sources of incalculable material wealth, as well as of vastly increased comfort and enjoyment to man.

These triumphs of modern science, are also the chief elements of our present civilisation, and for them the world is indebted chiefly to scientific bodies such as ours.

V. In adverting to the last head of this address, viz.:—on *the best way of encouraging and aiding such societies as ours*, I have to remark that it may be effected in two ways, viz,—*directly*, by grants and accommodations from the State; and *indirectly*, by creating among all classes of the population a greater taste for scientific pursuits.

1. Taking the indirect method first, it is hardly necessary to

point out how, as this scientific taste increases, persons will be more inclined to join societies of a scientific nature. The practical question then arises how this taste can be increased?

At a former period I had the faith which many others had in the efficacy of mechanics' institutes. But having had some experience of the working of these institutions, I am now satisfied that popular lectures do very little else than afford amusement,—though in that respect they are not altogether useless. But if they are to give instruction, and promote habits of observation, or a taste for scientific pursuits, they must inculcate and administer the hard discipline of personal study. Accordingly, many mechanics' institutes have established classes for different branches of study, and with much advantage.

I confess, however, that I have more faith in the instruction which begins at an earlier period of life than can be conveniently given at mechanics' institutes. I have seen that boys even under fourteen or fifteen years of age may acquire a taste for scientific pursuits, and habits of accurate observation—very serviceable, in whatever field of useful industry they may afterwards engage. No interference with essential branches of study would be necessary. In our Scottish parish schools, the time now spent in teaching French and German* to the children of the working classes, would perhaps be more usefully spent in teaching the elements of physiology, botany, chemistry, or geology; and as it is now the general practice in all primary schools to have an entire holiday on Saturday, that day of idleness or mischief would be more beneficially spent in a walk along the sea coast, or up a hill side, or through a rocky dell, or even along hedges and ditches, accompanied by a master competent to point out objects of interest. Who can doubt that in the course of such rambles, aided by a small amount of indoor instruction, seed would be sown in many a boy's mind and disposition, which would bear good fruit of a scientific kind in after years. I am glad to be able to say, that I know of several parish schools in East Lothian and in Perthshire, where the masters, having themselves a turn for science, have a class for instruction in the particular branch with which they are conversant. In one school,

* I see from this year's Education Report, that in the parochial schools, the number learning these languages is 2500.

chemical experiments are made once or twice in the month. In another school, the teacher has a telescope, through which he shows to the older boys of his school the moon and larger planets. In another school, a small collection of specimens has been formed to illustrate the rocks and minerals of the neighbourhood. The chief drawback in this matter, next to the want of teachers competent and well-disposed, has been the want of suitable text-books. But I am glad to find from the Secretary of the Education Committee, that this last drawback is being removed, as he has himself been preparing Elementary Science School Books, with the assistance of Professor Kelland, Professor Balfour, Mr Archer, Mr Geikie, and other eminent scientific men.

Whilst on the subject of scientific instruction in schools, I cannot avoid referring to the very gratifying encouragement given by the Government Department at South Kensington. That encouragement is very considerable, consisting not only of money rewards to pupils and teachers, but also of apparatus and books to schools. It is already producing fruit; for whilst last year, the number of schools in Scotland which received these Government grants amounted to 24, this year they are 45, being an increase of nearly 100 per cent.

Therefore, as these science and art classes in schools are multiplying, a taste for science will no doubt quickly germinate among the working and middle classes, thus supplying candidates in greater numbers for scientific pursuits and scientific societies.*

2. The foregoing remarks apply to the aids given *indirectly* to societies. I next notice the amount of aid given *directly* by the State.

Here it is proper to distinguish the aid given to science classes in schools, from the aid given to scientific societies. In the former

* Since this address was delivered, I see (*Nature*, Dec. 22, 1870) that an address has been presented by the President of the British Association for the Advancement of Science, supported by the office-bearers and an influential deputation, comprehending Sir Charles Lyell, Sir John Lubbock, Dr Lyon Playfair, and Mr Francis Galton,—to the Vice-President of the Privy Council Committee on Education, pointing out the expediency of authorising, in the new national elementary schools, systematic instruction in elementary science, so as to create a taste among the pupils, whereby they may be induced to follow out scientific studies in the more advanced schools.

case, aid is given for instruction in facts and principles which are already known. In the latter case, aid is given for searching new facts and new principles. It is very evident that the latter object is all important, if any advances in knowledge are to be made. Moreover, it is an object which needs more help from external sources. The student who obtains technical knowledge, or the knowledge which fits him for a profitable trade or profession, may not unfairly be left to pay the expense of his instruction, in consideration of the gains which that trade or profession will bring to him. With an investigator of scientific phenomena, who hopes to discover some new principle, the case is widely different. As his impelling motive is not the prospect of gain, so in nine cases out of ten the original discoverer of a new law, or a new principle, or a new product, is not the man who ever benefits by it in a pecuniary sense. Whilst he sows the seed, others reap the fruit, and yet, to procure the seed, probably much capital had to be spent and years of study endured, at the sacrifice of both health and fortune. Therefore the man who devotes his time to the discovery of new truths, and who bravely adheres to that pursuit in spite of difficulties and embarrassments, is surely a man standing in more need of help and encouragement than the engineer or artisan or mechanic who is receiving instruction which will enable him to follow a profitable profession. If the latter deserves assistance from the State, much more should the former. These investigators of science are the men of whom a country, when it possesses them, should be proud; and it would be a bad sign of the age if such men did not exist, or if no interest was felt about them. When ancient Rome was becoming degenerate, the question was significantly asked—"Quis nunc virtutem amplectitur, *præmia* si tollas?" So also it would be a sign of the degeneracy of a people, were no one to embrace science, except from the hope of profit; and it would be equally a sign of a degenerate Government, if it refused to encourage men of science and scientific societies.

In all civilised countries such encouragement is given in a greater or less degree, and in one form or another. Whether the amount of the encouragement given by the British Government is sufficient, is a point on which I at present offer no opinion.

But one thing is obvious, viz., that whatever were the difficulties which, thirty or forty years ago, investigators of new facts and new principles had to encounter, these difficulties are tenfold greater now, and therefore help to overcome these difficulties ought now to be more ample. The first discoveries in all the sciences were made by methods and processes far more simple than are now serviceable. The first steps in astronomy were made by the human eye alone. After all the knowledge was collected, which the unaided eye could supply, the next advances in the science were made by telescopes—telescopes simple and rude at first, but soon superseded by others of greater size and more accurate construction, so as to admit of a farther penetration into the depths of ethereal space, and a more minute examination of the movements and forms of the planetary bodies. When an eclipse of the sun has to be observed, the only way of now proceeding is, besides employing highly improved telescopes, to have also the spectroscope, the polariscope, and photographic apparatus; and, in order to use these instruments to the best advantage, large parties of observers must co-operate, and, at a great sacrifice of time and money, repair to favourable and probably remote spots on the earth's surface. So it is with all the other sciences. To enable a chemist to make discoveries now in his science, he must have apparatus and instruments ten times more numerous and expensive than those with which chemists formerly worked. The botanical physiologist can make no farther advances, except by means of powerful microscopes, which to his predecessor were unknown. For progress in meteorology, observations by individuals, in a few districts once or twice a day, are no longer of much avail. There must be a complete network of observations made over large portions of the earth's surface—and at least three or four times in the twenty-four hours. There must be self-recording instruments in particular districts, besides occasional ascents in a balloon. In short, there is no one science which can now be advanced by the same simple means which were available formerly. Science would stand still if improved methods were not resorted to. The difficulties, therefore, which men of science and scientific societies have to encounter in their researches are far greater than formerly, and what may have been a sufficient

amount of aid and encouragement to them twenty or thirty years ago is now manifestly quite inadequate.

Another obstacle in the way of farther discovery must not be overlooked. A great proportion of the philosophers who search after new truths and new principles are teachers, whose income as such alone enables them to obtain the means, scanty and precarious as it is, of prosecuting original investigations. But as knowledge advances, the labours of instruction increase;—and if the teacher does his duty in that capacity very little time is left to allow of extraneous investigations. Yet these persons are often better qualified to be investigators of new truths, than teachers of old truths. I have in my own experience met with professors in our universities whose occupation in the work of teaching deprived science of those who most probably would have been instrumental in making great discoveries.

The circumstances to which I have been adverting, as obstacles to the future advancement of science, were felt to be so serious, that two years ago they engaged the attention of the British Association—an association whose chief object it is "to give a stronger impulse and more systematic direction to scientific inquiry," and "to remove any disadvantages of a public kind which impede its progress." The view submitted to the Association by those who brought the subject before it was, that as there are institutions for teaching old truths, so there ought to be institutions for discovering new truths, and that, as this last work had now become so difficult and costly, that few individuals could enter on it from their own resources, the State—which, on behalf of the great interests of the country, is interested to encourage discoveries and investigations—ought to come forward and establish institutions, in which men with an aptitude for original investigations might have facilities for carrying them on, without being distracted by any other vocation.

The British Association so far entered into these views as to appoint a committee, consisting of some of its most eminent and influential members, and the two following questions were put to the committee for consideration :—

"(1.) Does there exist in the United Kingdom of Great Britain and Ireland sufficient provision for the vigorous prosecution of physical research?

"(2.) If not, what further provision is needed, and what measures should be taken to secure it?"

At the meeting of the Association in 1869 that committee reported—

"(1.) That the provision now existing in the United Kingdom of Great Britain and Ireland is far from sufficient for the vigorous prosecution of physical research.

"(2.) That, whilst greatly increased facilities for extending and systematising physical research are required, your committee do not consider it expedient that they should attempt to define how these facilities should be provided."

In explanation of this last finding, the committee observed that—

"Any scheme of scientific extension should be based on a full and accurate knowledge of the amount of aid now given to science, of the sources from which that aid is derived, and of the functions performed by individuals and institutions receiving such aid. Your committee have found it impossible, with the means and powers at their command, to acquire this knowledge. Moreover, as the whole question of the relation of the State to science, at present in a very unsettled and unsatisfactory position, is involved, they urge that a Royal Commission alone is competent to deal with the subject."

The Association approved of this report, and appointed application to be made to her Majesty's Government to appoint a Royal Commission to consider the whole subject. This application was successful; for, in May 1870, the *Gazette* announced the names of nine Commissioners, with power "to make inquiry with regard to Scientific Instruction and the Advancement of Science, and to inquire what aid thereto is derived from grants voted by Parliament, or from endowments belonging to the several Universities in Great Britain and Ireland, and the Colleges thereof, and whether such aid could be rendered in a manner more effectual for the purpose."

The importance of this measure I need not dwell upon. The backwardness of the British Government to aid institutions and individuals devoted to scientific investigations, and the miserable amount of any pittances conceded to them, affect the credit and prosperity of the country quite as much as the interests of science. Great Britain, whose influence in the world depends almost more on moral than on physical power, ought not to be behind other

nations in its patronage of science. Yet what has happened within the last six weeks? A remarkable eclipse of the sun, to take place on the 22d of this month, had been looked forward to by astronomers as affording an excellent opportunity for solving many important questions regarding the constitution of that great orb on which all living things in our planet, and in other planets also, depend; but, for the proper observation of which eclipse, expeditions were necessary, requiring much previous preparation and great expense. The United States Government, even eight months ago, began preparations, a sum of L.6400 having been unanimously voted by Congress,* and a Government officer despatched to visit Spain and Sicily, to find proper places of observation, and to make suitable arrangements for the reception of a party of astronomers. A ship of the United States navy was appointed to convey them, accompanied by two eminent engineer officers, representing the Government, to take a general charge.

In England what were the arrangements for this interesting astronomical phenomenon? Early last spring, on the suggestion of the Astronomer Royal, a committee was formed, consisting of himself and the Presidents of the Royal Astronomical Society, and of the Royal Society of London, to organise an expedition. A party of astronomers soon volunteered, about sixty in number, who were to be divided into two parties, one for Spain and another for Sicily, each subdivided into sections, to make different kinds of observations, with suitable instruments. As total obscuration would last only two minutes, the more that the work could be

* The following appropriations, under the head of Astronomy and Meteorology, were made by Congress, as given in "*Nature*," Jan. 26, 1871:—

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|---|---|
| Observations of Eclipse, Dec. 1870, under Coast Survey, | 29,000 dols. |
| U. S. Nautical Almanac, . . . . | 20,000 „ |
| National Observatory, . . . . . | 19,800 „ |
| New Telescope for do, . . . . . | 50,000 „ |
| Telegraphic Notices of Storms, . . . | 50,000 „ |

In the same Congress there were additional appropriations to the amount of no less than 1,377,766 dollars, for the support of Museums, Botanic Gardens, Mining Statistics, Polar Explorations, Surveys, and other objects of a scientific nature. These appropriations, be it observed, were by the Federal Government. Similar appropriations, but larger altogether in amount, are made by the different States in aid of their own societies.

distributed among different observers the better. The Committee had entertained no doubt that her Majesty's Government would give ready, if not liberal, assistance. On the last occasion of a solar eclipse—viz., in 1868—several European Governments sent expeditions to India, where it could best be viewed. Ours gave the use of a ship, besides appointing officers, and paying expenses. But when the committee, last summer, applied to the Admiralty to ascertain if one of her Majesty's ships would be allowed to convey the English astronomers, the answer they received was that Parliament had not placed either ships or funds at the disposal of the Admiralty for any such purpose. This was a rebuff little anticipated; and, I may add, little deserved by those of our countrymen, who, in a noble spirit of disinterestedness, had offered to give up their time, and leave their homes, to undergo fatigue and risk in the cause of science. In consequence of this answer some delay arose, to consider what was to be done. An appeal against the decision of the Admiralty, to the Premier and the Chancellor of the Exchequer, was resolved on. Some farther delay occurred in consequence of the absence of these high functionaries from London. Meanwhile, the United States ship arrived in England, bringing with them the American astronomers. They soon learnt the unsatisfactory position of the negotiation with our Government; and, in consequence of it, they sent a formal invitation through their director, inviting the English astronomers to accompany them in their ship to Spain and Sicily. This letter was published in the London newspapers; and severe comments were made by the press on our executive, if they should oblige the English party to avail themselves of the invitation, and be beholden to a foreign Government for assistance. Fortunately for the credit of the country, our Government at length yielded to the pressure. A sum of L.3000 was agreed to be set apart to pay expenses, and a troop ship was appointed to convey the party and their instruments. But no Government astronomer received authority to accompany the expedition, and no engineer officer, or other official representing the Government, was appointed to take charge of the expedition, and give assistance. In all these respects the British Government fell far short of what had been done by the United States Government, to aid in the cause.

I have related thus fully the circumstances connected with this Solar Eclipse Expedition, because it has occurred recently, and therefore shows too plainly the indifference to science, and to men of science, which actuates those who manage the affairs of this country. It is, however, a charge which unfortunately does not lie at the door of the present executive alone. The same indifference has been too clearly manifested by almost all preceding Governments. Unmistakable evidence of this indifference is afforded by the treatment of the societies and associations formed for the advancement of science. What aid is given to any of these? The only part of the United Kingdom in which such aid is liberally given is in Ireland.* Except to the Academy of Music in London, which receives annually a grant of L.500, I know of no Society of a scientific character, either in England or in Scotland, which receives any grant to carry out its special objects. The only patronage to English scientific societies consists in the free use of Government apartments in London to seven of these societies, and the free use of Government apartments in Edinburgh to two Scotch societies—viz., the Royal Society and the Society of Antiquaries.† There is another society which has been very kindly allowed to occupy two small apartments in the General Post-Office Buildings; but for the use of these a rent is exacted; and, moreover, from this society statistical information is obtained by Government, for which, however, Government does not pay, and declines to pay.

This illiberal feature of the British Government in not aiding voluntary associations for scientific objects, is the more remarkable considering the principle which our Government adopts for

* In Dublin there are six societies, two of which are for the encouragement of the fine arts, particularly painting, which receive about L.13,000 yearly, to enable them to carry out their special objects and to keep their buildings in repair. (See Report of Royal Commissioners on Aid given to Irish Societies, presented to Parliament in 1869.)

† The Royal Society of Edinburgh has, since the year 1836, received from the Exchequer a yearly sum of L.300 to enable them to pay rent, taxes, and maintenance of the apartments they occupy. The rent charged by Government for these apartments is L.260. The Society of Antiquaries receives L.300, which is all applied to pay the officers who take charge of the Museum, and the necessary repairs and cleaning. The Museum belongs to the Government.

other associations having objects not more beneficial to the public. The principle is, that when funds are voluntarily supplied from local sources, the State supplements these by an addition of as much money from the Exchequer. The local subscriptions are justly taken as evidence that the objects are praiseworthy, and that they are appreciated by the community; whilst any risk of misapplication or mismanagement is avoided by an annual report to Government. This principle has been applied to schools and various other educational institutions, to volunteer corps, to county constabulary, &c.

Whilst pointing out the illiberal, short-sighted, and inconsistent policy of the British Government in not assisting scientific societies with pecuniary grants to aid them, it would be wrong in me not to take grateful notice of a parliamentary grant of L.1000 a year given to encourage scientific investigations carried on anywhere in the United Kingdom or colonies of Great Britain. Of this grant I could find no authentic account in any publication. General rumour only was my authority for believing that such a grant existed, and that it was at the disposal of the Royal Society of London. On my speaking to Professor Balfour on the subject, I found that he could give me no information, but he kindly undertook to apply to Dr Sharpey, the secretary of the Royal Society of London. Dr Sharpey at once responded, by sending a memorandum explanatory of the grant—a memorandum which appears to me of sufficient importance to be now laid before our Society:—

"MEMORANDUM as to the 'Government Grant' placed annually at the disposal of the Royal Society.—Nov. 30, 1870.

"In 1849 the First Lord of the Treasury (Lord John Russell) *offered*, on the part of the Government, to place L.1000 at the disposal of the Royal Society, to be by them applied towards the advancement of science.

"This offer was accepted. The first payment was made in 1850, and it has been repeated annually up to the present time. Up to 1855 the grant was paid from a special fund at the disposal of the Treasury, but since then it has been annually voted by Parliament.

"The Council of the Royal Society consider the grant as a contribution on the part of the nation towards the promotion of science

generally in her Majesty's dominions, regarding themselves as trustees of the grant, and accountable to the public for its due administration, as long as it shall be continued.

"To aid the Council in the distribution of the fund, a committee is annually appointed, consisting of the 21 members of the Council and 21 Fellows of the Society not on the Council, selected on account of their acquaintance with the different branches of science which the Society cultivates. All applications for grants from the fund are submitted to this committee, and the appropriations are made by the Council on the committee's recommendation.

"The grants are commonly made to individuals engaged in some definite scientific investigation, chiefly to meet the expense of apparatus and materials, and not as remuneration for time or labour bestowed by the inquirer. To a less extent appropriations have been made for like purposes to scientific institutions, and, more rarely, to aid in the publication of valuable scientific results.

"The distribution of the fund is not restricted to Fellows of the Royal Society, nor have they any privilege in regard to it; men of science, whether belonging to the Society or not, and wherever they may carry on their researches, in this country or the colonies, have an equal title to participate, and their claims have been in all cases equally recognised.

"No part of the fund is applied towards the expenses of the Royal Society, and the Society neither asks nor would accept any remuneration for its stewardship.

"It is to be noted that, in 1864, the Council, finding that the unappropriated balance, together with other funds at their disposal, would meet the probable demands for scientific objects, repaid the grant of that year into the Exchequer.

"A return was made to Parliament in 1855, stating the application of the fund for the five years ending 5th April 1855. This statement will be found printed in the 'Proceedings of the Royal Society,' vol. vii. page 512. A second return was made in 1862, showing the distribution of the fund from 1855 to 1862. No later return has been called for, although the Council would be glad to make it if ordered.

"It is proposed hereafter to publish an annual statement of the disposal of the grant in the Proceedings. W. S."

Dr Sharpey, besides drawing out the foregoing memorandum, explaining the origin and objects of this parliamentary grant, has been so obliging as to send two printed returns, giving for the first twelve years the names of the persons who have shared in the grant, and the nature of the researches aided. Besides these returns (to Parliament), he has sent a statement—apparently not yet published—containing similar information for the years 1869 and 1870. For the years from 1862 to 1869, no information is given, except that in the year 1864, as the memorandum mentions, the remarkable circumstance occurred, of the Society having paid back to Government the L.1000, in consequence of there being no claims on it which could not be otherwise met.

Now, no one who looks at the returns showing how these annual grants were expended, will question the judicious and impartial manner in which they have been administered. I would, however, venture to remark, that as the grant was intended to assist scientific researches in all parts of her Majesty's dominions, colonies included, some means should have been taken to make the existence and the objects of the grant publicly known. The grant would, of course, be known to the Fellows of the Royal Society of London, but it has remained ever since its institution, now twenty years ago, generally unknown to men of science, and especially to persons resident in Scotland and Ireland. It is therefore not surprising that, in the year 1864, there being no demands on the grant, it had to be paid back to Government; and that out of the L.14,000 embraced by the returns, no more than L.610 should have been expended on researches in Scotland. The great part of these researches was made by two individuals, both of them Fellows of the Royal Society of London.

It appears to me that, so far as the interests of science in Scotland are concerned, these interests, if intended to be aided by a pecuniary grant from the State, would be better promoted were the grant administered by a suitable board in Scotland, instead of by one in London. Any researches and experiments carried on in Scotland, and the scientific character of the men who carry them on, must surely be better known in Edinburgh than in London. Limited as are my own opportunities of knowing of such researches and experiments, I may refer to some on the difficult

and important subject of ozone, which, after being carried on for some time in the Edinburgh Botanic Garden last year,* had to be discontinued on account of the want of apparatus and instruments which those who instituted them had no means of paying for.†

I certainly do not wish, however, that the grant of L.1000, which is at the disposal of the Royal Society of London, should be split up, so that a part of it may be administered to a Scotch Society, if the London Royal Society think that they can apply it all usefully in England. All that I contend for is, that when parliamentary grants are voted for aiding scientific researches throughout the United Kingdom, it is not a judicious arrangement for the object in view to place these grants at the exclusive disposal of a society in London, when there are societies in Scotland and in Ireland competent to be intrusted with the duty. A committee of the Royal Society of London are also intrusted with the administration of the still larger parliamentary grant of L.10,000 a year for meteorological purposes,—a considerable part of which grant is devoted to the obtaining of meteorological returns from Scotland, and of establishing self-recording instruments in Scotland, besides upholding other stations. Our own Royal Society has from time to time done a good deal to promote meteorology in Scotland,—Sir David Brewster, Sir Thomas M. Brisbane, and Principal Forbes, having been distinguished meteorologists, and published largely in our Transactions. There is also a society in Scotland specially devoted to that science, which is allowed to be doing useful work. Yet neither society has any voice in the administration of that large grant of L.10,000 a year.

Whilst as regards the interests of science it seems more expe-

* See an account of these experiments in the "Journal of the Scottish Meterological Society" for January 1869.

† The test papers for ozone indications are affected by the varying force of wind, as also by the varying humidity of the atmosphere, insomuch that at several Observatories ozone observations have been discontinued. When I was at Rome last winter, Padre Secchi told me he had ceased to take notice of ozone for these reasons, not having been able to devise any method for eliminating the effects of wind and moisture. The object of the experiments in the Edinburgh Botanic Garden was to construct an apparatus which should allow only dry air to reach the test papers, and in certain quantities.

dient that the board intrusted with the expenditure in Scotland should be in Edinburgh rather than in London, is it not also a slur on Scotch scientific societies that they should be altogether ignored, and a London society selected, as if the former were unworthy, or could not be trusted?

I therefore regret this system of centralisation in London, and cannot help thinking that our Society ought not so tacitly to acquiesce in it. In one of his addresses from this chair, Sir David Brewster, in alluding to the annual grant of L.1000, as well as the two royal medals, placed at the disposal of the Royal Society of London, expressed his belief "that an earnest representation made to the Government would obtain for us a similar, though probably a smaller grant;" and it humbly appears to me that such a representation ought to be made without farther delay.

The expediency of energetic action on our part is more manifest because of a proposal made lately in an influential quarter to enlarge the amount of the grant to the Royal Society of London. Professor Balfour Stewart a few weeks ago, at the inauguration of Owen's College, Manchester, in his opening address there, made the following remarks:—

"If Government be disposed to grant pecuniary aid to physical researches, an extension of the allowance made annually to the Government Grant Committee of the Royal Society, would be a very legitimate way of accomplishing this object. No one can doubt that the small sum of L.1000 annually intrusted by Government to that Society for miscellaneous experiments is administered in a praiseworthy manner; and if the Government would be ready to grant, and the Royal Society willing to undertake, an extension of this trust, it would be a great point gained."*

This suggestion will no doubt obtain consideration from the Royal Commissioners appointed to report whether the State now gives enough for the encouragement of science. All or most of these commissioners are Fellows of the Royal Society of London, and two of them are office-bearers of the Society. A fairer selection of eminent men for the object in view could not have been made; and though none of them are Fellows of the Royal Society of Edinburgh, I am sure that they will not on that account be less

* Lieutenant-Colonel Strange, an influential member of the British Association, sends a letter to "*Nature*," Nov. 3, 1870, in which he adverts to Professor Balfour Stewart's idea of enlarging the grant of L.1000 administered by the Royal Society of London, and expresses cordial concurrence.

disposed, perhaps the more disposed, to listen to any representation which we may lay before them.

But, apart from our own interest as a society in the deliberations of these Royal Commissioners, I entertain a very sanguine hope that much good will accrue from them. The very concession of a Commission on the part of Government seems to imply a conviction and acknowledgment, that the patronage hitherto given in this country to science is not what it should have been, and that reform in this respect is quite as much needed as in other matters. We have been lately confessing our shortcomings as regards national schools, and are endeavouring to remedy these; but we ought not to be satisfied with merely teaching old truths and well-known facts. The investigation of new truths and new facts, and the opening out of new pathways in the wide field of knowledge, are also necessary if we are to help in extending civilisation, and if we are to uphold our position in the family of nations. It should no longer be left to the chance of individuals being found to carry on, from their own resources, the great and noble work of making fresh discoveries in science and art. That work is worthy of State patronage, as it also more than ever needs State assistance; and unless that work is carried on energetically and successfully, we shall lose caste as an enlightened people, and see the chief sources of our prosperity and power dried up.

Therefore I look forward, with no small anxiety, to the report of these Royal Commissioners. But I confidently anticipate favourable results; and in pointing out the best channels through which aid to science from the State may flow, I have no doubt that our own past services, and our present efficiency as a society, will not be overlooked.

In these expectations I may possibly be over-sanguine, and therefore allow me to add, in conclusion, a single remark as to our own duty in this matter:—As a society, and so far as our scanty funds enable us, we will continue to encourage scientific researches in Scotland, not forgetting, however, that we have also literary objects; and as Fellows of the Society,—a Society which during its time has done much in the cause of science, and something too on behalf of literature, we will do what we can to uphold its reputation, and extend its influence and usefulness.

The following Gentleman was elected a Fellow of the Society :—

JOHN AULD, Esq., W.S.

*Monday, 19th December* 1870.

DR CHRISTISON, President, in the Chair.

The following Communications were read :—

1. Additional Remarks on the Theory of Capillary Attraction. By Edward Sang, Esq.

2. Laboratory Notes : On Thermo-Electricity. By Professor Tait.

In a paper presented to the Society in 1867–8 I deduced from certain hypothetical considerations regarding Dissipation of Energy results connected with the thermal and electric conductivity of bodies, the electric convection of heat, &c. As these were all of a confessedly somewhat speculative character, I printed at the time only that connected with thermal conductivity, which I had the means of comparing with experiment, and which seemed to accord fairly with Forbes' experimental results. But the assumption on which this was based was essentially involved in all the other portions of the paper.

With a view to the testing of my hypothetical result as to electric convection of heat, several of my students, especially Messrs May and Straker, last summer made a careful determination of the electromotive force in various thermo-electric circuits through wide ranges of temperature. Their results for a standard iron-wire, connected successively with two very different specimens of copper, when plotted, showed curves so closely resembling parabolas that I was led to look over my former investigations and determine what, on my hypothetical reasoning, the curves should be. This I had entirely omitted to do. I easily found that the parabola ought, on my hypothesis, to be the curve in every case, and I made last August a numerous and careful set of determinations with Kew standard mercurial thermometers as an additional verification.

My hypothetical result was to the effect that what Thomson (Trans. R.S.E. 1854, Phil. Trans. 1856) calls the specific heat of electricity, should be, like thermal and electric resistance, directly proportional in pure metals to the absolute temperature, the coefficient of proportionality being, for some substances, negative.

Hence, using Thomson's notation as in Trans. R.S.E., we have for any two metals

$$J\sigma_1 = k_1 t\ ,\quad J\sigma_2 = k_2 t\ ,$$

where $k_1$ and $k_2$ are constants, whose sign as well as value depends on the properties of each metal, $\sigma_1$, $\sigma_2$ are the specific heats of electricity, and J is Joule's Equivalent.

Thus, introducing these values into Thomson's formulæ, we have

$$(k_1 - k_2)t = J(\sigma_1 - \sigma_2) = J\left(\frac{\Pi}{t} - \frac{d\Pi}{dt}\right),$$

where $\Pi$ is the Peltier effect at a junction at absolute temperature $t$. Integrating, we have

$$C - (k_1 - k_2)t = J\frac{\Pi}{t}\ ,$$

or

$$J\frac{\Pi}{t} = (k_1 - k_2)(t_0 - t)\ ,$$

where $t_0$ is the constant of integration, obviously in this case the temperature at which the two metals are thermo-electrically neutral to one another. Hence the Peltier effect may be represented by the ordinates of a parabola of which temperatures are the abscissæ; the ordinates being parallel to the axis of the curve.

The electromotive force in a circuit whose junctions are at absolute temperatures $t$ and $t'$ is then represented by

$$E = J\int_{t'}^{t}\frac{\Pi}{t}\,dt = \tfrac{1}{2}(k_1 - k_2)[2t_0(t - t') - (t^2 - t'^2)]$$

$$= (k_1 - k_2)(t - t')\left[t_0 - \frac{t + t'}{2}\right].$$

This, of course, is again the equation of a parabola. That $t - t'$ is a factor of E has long been known, and Thomson has given the results of many experiments tending to show that $t_0 - \frac{t + t'}{2}$ is also

a factor. But it was not till the experiments in my Laboratory had been carried on for some months that I was referred by Thomson to a paper by Avenarius (*Pogg. Ann.* 119), in which it is experimentally proved (partly in contradiction of an assertion of Becquerel) that in a series of five different thermo-electric circuits the electro-motive force can be very accurately expressed by *two* terms of the assumed series

$$E = b(t - t_2) + c(t_1^2 - t_2^2) + \quad . \quad . \quad .$$

where $t_1$ and $t_2$ are temperatures as shown by the ordinary mercurial thermometer. It follows from this that (neglecting the difference between absolute temperatures and those given by the mercurial thermometer) E has no other variable factor than those above given.

Curiously enough, Avenarius, whose paper seems to have been written mainly for the purpose of attempting to explain (by the consideration merely of the effect of heat on electricity of contact of two metals) the production of thermo-electric currents, does not allude to the fact that the above equation represents a parabola. In fact he gives several figures, in all of which it is represented as a very accurately drawn *semicircle*. He makes no application of his empirical formula to the determination of the amount of the Peltier effect, nor does he seem to recognise the existence of what Le Roux has called "l'effet Thomson," which is indispensable to the explanation of the observed phenomena.

All the curves plotted by Messrs May and Straker, which were derived from iron, copper, and platinum alone, as well as my own, which included cadmium, zinc, tin, lead, brass, silver, and various other substances (sometimes arranged with a double arc of two different metals connecting the hot and cold junctions) were excellent parabolas. When the temperatures were very high, the parabola was slightly steeper on the hotter than on the colder side. This, however, was a deviation of very small amount, and quite within the limits of error introduced by the altered resistance of the circuit at the hotter parts, the deviations of the mercury thermometers from absolute temperature, and the non-correction of the indication of the thermometers for the long column of mercury not immersed in the hot oil round the junction.

To settle the question rigorously, I have been for some time ex-

perimenting with an arrangement sometimes of double metallic arcs, sometimes of two separate thermo-electric circuits acting on a differential galvanometer—a second object being to obtain, if it be possible, an arrangement capable of replacing with sufficient accuracy the air-thermometer in the measurement of very high temperatures, and where very exact results are not required.

In fact, if the formula above be correct, we have for two circuits with their junctions immersed in the same vessels

$$\mathrm{E} = a(t - t_1)\left(t_0 - \frac{t + t_1}{2}\right)$$

$$\mathrm{E}' = a'(t - t_1)\left(t'_0 - \frac{t + t_1}{2}\right)$$

so that if the resistances in the circuits be made as $a$ to $a'$ their resultant effect on the differential galvanometer will be proportional to

$$(t_0 - t'_0)(t - t_1).$$

It is obvious that so far as these factors are concerned the most sensitive arrangements will be such as have their neutral points farthest apart. On a future occasion I hope to lay the results of my new experiments before the Society. They appear to promise to be of great use in furnishing an easily working and approximately accurate substitute for the air-thermometer in an inquiry on which I am engaged respecting specific heats and melting points of various igneous rocks, &c., while the comparison of the indications of two such arrangements at very high temperatures will give the means of determining whether the quantities called $k$ above are really constants.

## 3. Note on Linear Differential Equations in Quaternions. By Professor Tait.

The generally non-commutative character of quaternion multiplication introduces into the solution even of linear differential equations with constant (quaternion) coefficients, difficulties of a somewhat novel character. To some of these which have presented themselves to me in many investigations, I wish to draw attention in the following note, but want of leisure prevents my attempting at present either to classify the numerous curious forms which may be met with in physical inquiries, even when these lead to mere

vector equations of an order no higher than the second, or to develope the subject of the curious functional equations which are incidentally involved.

1. The integration of an equation such as

$$\dot{q} + mq = \alpha ,$$

where $m$ is a *scalar* (usually a function of $t$, which is assumed throughout as the independent variable), and $q$ an unknown quaternion, is obviously to be effected by the ordinary method, multiplication by $\varepsilon^{\int m dt}$.

2. But if $a$ be a *quaternion*, the integration of

$$\dot{q} + aq = \alpha' ,$$

even when $a$ is constant, requires a little care, unless we boldly treat $a$ as $m$ was treated in the preceding section. This, no doubt, gives the correct result, but the process requires to be defended. Assume therefore $r$ to be a factor which makes the left hand member integrable. Then we must have

$$\dot{r} = ra ,$$

or, if $r'$ be a proximate value of $r$,

$$r' = r + \dot{r}\delta t = r(1 + a\delta t) .$$

Hence, dividing the finite interval $t$ into a great number of equal parts, and taking the limit

$$r = r_0 \, \mathrm{L}_\infty \left(1 + \frac{at}{n}\right)^n$$

$$= r_0 \, \varepsilon^{at}$$

where $r_0$ is an arbitrary but constant quaternion.

Now we have

$$\varepsilon^{at} = \varepsilon^{t(Sa + TVa \,.\, UVa)} = \varepsilon^{t(m + n\alpha)}, \text{ suppose}$$

$$= \varepsilon^{mt} \alpha^{\frac{2nt}{\pi}} .$$

Hence the solution of the given equation is

$$\varepsilon^{mt} \alpha^{\frac{2nt}{\pi}} q = \int \varepsilon^{mt} \alpha^{\frac{2nt}{\pi}} \alpha' \, dt ,$$

the arbitrary quaternion constant $r_0$ having disappeared, but a new one being introduced by the integration on the right.

When $a$ is variable, the tensor of $r$ is easily seen to be $\varepsilon^{\int Sadt}$, but its versor, $s$, is to be found from the equation

$$\dot{s} = sVa$$

the fundamental relation between the instantaneous axis and the versor of rotation of a rigid body (*Trans. R.S.E.*, 1868).

When $r$ is a vector, $\theta$ suppose, we have

$$\dot{\theta} = V\theta a,$$

whence, as above,

$$\theta = V\theta_0 \varepsilon^{\int adt}.$$

3. In the succeeding examples we restrict ourselves to equations for the determination of unknown *vectors*, as we thus avoid the introduction of the quartic equation which has been shown by Hamilton to be satisfied by a linear function of a *quaternion*. This would appear, for instance, in the solution of even the simple equation

$$\dot{q} + aqb = c$$

where $a$ and $b$ are constant quaternions; though, of course, its use may be avoided by employing a somewhat more cumbrous process.

4. Suppose we have

$$\dot{\rho} + \varphi\rho = \alpha$$

where $\varphi$ is a self-conjugate linear and vector function with constant constituents. Operate by $S.\delta$, and we have

$$S\delta\dot{\rho} + S.\rho\varphi\delta = S\delta\alpha.$$

The left hand side is a complete differential if

$$\dot{\delta} = \varphi\delta.$$

The general integral of this equation may be written as

$$\delta = \varepsilon^{t\Phi}\delta_0$$

where $\varepsilon^{\Phi}$ is another linear and vector function; but it is not necessary to discuss here the validity of such a result, deduced as it must be by a process of separation of symbols. [See Tait's *Quaternions*, § 290.] For, on account of the properties of $\varphi$, we may

assume (since but three distinct and non-coplanar values of $\delta$ are required)

$$\delta = x\,\eta$$

where $\eta$ is a constant unit-vector, and $x$ a scalar function of $t$. This gives

$$\frac{\dot{x}}{x}\eta = \varphi\eta\,.$$

The values of $\eta$ are therefore unit-vectors parallel to the axes of the surface

$$\mathrm{S}\,\rho\varphi\rho = 1\,,$$

and those of $\frac{\dot{x}}{x}$ are the roots of the auxiliary cubic in $\varphi$. Call them $\eta_1, \eta_2, \eta_3$ and $g_1, g_2, g_3$ respectively, then the values of $\delta$ (into which no arbitrary constant need be introduced), are of the form

$$\varepsilon^{gt}\eta\,.$$

Thus, finally,

$$\begin{aligned}\rho &= -\,\Sigma\eta\mathrm{S}\eta\rho \\ &= -\,\Sigma\varepsilon^{-gt}\eta\left[\int\varepsilon^{gt}\mathrm{S}\eta\alpha dt + \mathrm{C}\right].\end{aligned}$$

5. If, in the equation of (4), we suppose $\alpha$ constant, we may easily apply a process similar to that of (2).

For

$$\rho' = \rho + \dot{\rho}\delta t = (1 - \delta t\,.\,\varphi)\,\rho + \alpha\delta t\,.$$

Hence, as $\alpha$ is constant,

$$\begin{aligned}\rho &= \mathrm{L}_\infty\left(1 - \frac{t\varphi}{n}\right)^n\rho_0 + \mathrm{L}_\infty\frac{\left(1 - \frac{t\varphi}{n}\right)^n - 1}{\left(1 - \frac{t\varphi}{n}\right) - 1}\cdot\frac{\alpha t}{n} \\ &= \varepsilon^{-t\varphi}\,\rho_0 + \varphi^{-1}\alpha\end{aligned}$$

where $\rho_0$ (which is arbitrary) has been increased by $\varphi^{-1}\alpha$. It is easy to show that this agrees with the final result of (4), and the coincidence is so far a justification of the use of the method of separation of symbols.

The verification of the general result of (4), where $\alpha$ is variable, can also be effected by this method, but not so readily.

6. Let us take the linear equation of the second order with

constant coefficients (equivalent to three simultaneous linear equations in scalars of a very general form)

$$\ddot{\rho} + \varphi\dot{\rho} + \psi\rho = 0,$$

where $\varphi$ and $\psi$ may, or may not, be self-conjugate.

If they be self-conjugate, this represents oscillation under the action of a force whose components, in each of three rectangular directions, are made up of parts proportional to (though not necessarily equimultiples of) the displacements in these directions. The resistance parallel to each of three other rectangular directions depends in a similar manner on the corresponding components of the velocity.

The operator in the left hand member may be written

$$\left(\frac{d}{dt}\right)^2 + \varphi.\frac{d}{dt} + \psi = \left(\frac{d}{dt} + \chi\right)\left(\frac{d}{dt} + \theta\right),$$

suppose, where $\chi$ and $\theta$ are two new linear and vector functions.

Hence, comparing, we must have

$$\chi + \theta = \varphi$$
$$\chi\theta = \psi,$$

or, eliminating $\theta$,

$$\chi^2 + \psi = \chi\varphi$$

a curious and apparently novel species of equation from which to determine the function $\chi$.

[We might have arrived at it, by a somewhat more perilous but shorter route, by assuming as a particular integral of the given equation the expression

$$\rho = \epsilon^{-t\chi}\rho_0.]$$

If we take their conjugates in addition to the two equations connecting $\theta$ and $\chi$, we see at once that all four are satisfied by assuming these two functions to be conjugate to one another, provided $\varphi$ and $\psi$ are self-conjugate. Hence in this special case we may write

$$\left.\begin{aligned}\chi &= \tfrac{1}{2}\varphi + \mathrm{V}.\epsilon\\ \theta &= \tfrac{1}{2}\varphi - \mathrm{V}.\epsilon\end{aligned}\right\}.$$

It only remains that we should find $\epsilon$, and the rest of the solution is to be effected as in (4) or (5).

We have

$$\psi = \chi\theta = \frac{\varphi^2}{4} + \frac{1}{2}(\mathrm{V}.\epsilon\varphi - \varphi\mathrm{V}.\epsilon) - \mathrm{V}.\epsilon\mathrm{V}.\epsilon .$$

When $\varphi$ is a constant scalar, *i.e.*, when the resistance is in the direction of motion (which is the case generally in physical applications) the middle term vanishes, and we have

$$\mathrm{V}.\epsilon\mathrm{V}.\epsilon = \frac{\varphi^2}{4} - \psi ,$$

or, as it may be written,

$$\mathrm{V}.\epsilon = \left(\frac{\varphi^2}{4} - \psi\right)^{\frac{1}{2}} .$$

In fact, in this case, $\varphi$ and $\chi$ are commutative in multiplication, so that the equation in $\chi$ may be solved as an ordinary quadratic.

Even this very particular case involves a singular question, though not one of such difficulty as that of the general problem above. We have, in fact, to solve an equation of the form

$$\varpi^2 = \omega ,$$

where $\omega$ is a given, and $\varpi$ a sought, linear and vector function. This leads to an equation of the sixth degree in $\varpi$ with pairs of roots equal but of opposite signs. The coefficients of the cubic in $\varpi$ are formed by the solution of a biquadratic equation.*

* Suppose the cubic in $\varpi$ to be

$$\varpi^3 + g\varpi^2 + g_1\varpi + g_2 = 0 ,$$

the given equation enables us to write it in either of the (really identical) forms

$$(\varpi + g)\omega + g_1\varpi + g_2 = 0 ,$$

or

$$\varpi(\omega + g_1) + g\omega + g_2 = 0 ;$$

whence

$$\omega = \left(\frac{g\omega + g_2}{\omega + g_1}\right)^2 ,$$

or

$$\omega^3 + (2g_1 - g^2)\omega^2 + (g_1^2 - 2gg_2)\omega - g_2^2 = 0 .$$

If the cubic in $\omega$ be

$$\omega^3 + m\omega^2 + m_1\omega + m_2 = 0 ,$$

we have by comparison of co-efficients

$$2g_1 - g^2 = m , \quad g_1^2 - 2gg_2 = m_1 , \quad g_2^2 = -m_2$$

so that $g_2$ is known and

$$g = \frac{g_1^2 - m_1}{2\sqrt{-m_2}}$$

In fact, if we apply the members of the general equation above to $\epsilon$, we have

$$\mathrm{V}.\epsilon\varphi\epsilon = 2\left(\psi - \frac{\varphi^2}{4}\right)\epsilon .$$

This leads to the two equations

$$\mathrm{S}.\epsilon\left(\psi - \frac{\varphi^2}{4}\right)\epsilon = 0 ,$$

$$\mathrm{S}.\epsilon\varphi\left(\psi - \frac{\varphi^2}{4}\right)\epsilon = 0 ,$$

which, belonging to two cones of the second degree, give in general four values of $\epsilon$.

7. The interest of the general question before us, from the analytical point of view, lies mainly in the determination of the two unknown linear and vector functions $\chi$ and $\theta$ from the equations

$$\chi + \theta = \varphi ,$$
$$\chi\theta = \psi ,$$

each of which is in general equivalent to *nine* or in certain cases *six* (not, as in ordinary quaternion equations, *four*, or as in vector equations *three*) simultaneous scalar equations. They have also a

where

$$2g_1 = m - \frac{(g_1^2 - m_1)^2}{4m_2} .$$

The values of $g$ being found, $\varpi$ is given by the expression above.

A similar process may easily be applied to the general equation of (6), but it may be well to exhibit the present simple case in its Cartesian form.

Let $\mathrm{S}i\omega i = p_1$, $\mathrm{S}i\omega j = p_2$, $\mathrm{S}i\omega k = p_3$,
$\mathrm{S}j\omega i = q_1$, $\mathrm{S}j\omega j = q_2$, $\mathrm{S}j\omega k = q_3$,
$\mathrm{S}k\omega i = r_1$, $\mathrm{S}k\omega j = r_2$, $\mathrm{S}k\omega k = r_3$.

Also let $\varpi = \alpha\mathrm{S}i + \beta\mathrm{S}j + \gamma\mathrm{S}k$,

where $\alpha = ix_1 + jx_2 + kx_3$,
$\beta = iy_1 + jy_2 + ky_3$,
$\gamma = iz_1 + jz_2 + kz_3$,

then the problem reduces itself to the determination of the nine scalars $x$, $y$, $z$, &c., from nine equations of the second degree, of which we write only the first three:—viz.

$$x_1^2 + y_1x_2 + z_1x_3 = p_1 ,$$
$$x_2x_1 + y_2x_2 + z_2x_3 = p_2 ,$$
$$x_3x_1 + y_3x_2 + z_3x_3 = p_3 .$$

physical interest, inasmuch as they include the problem of finding two homogeneous strains, such that the vector-sum of their effects on any vector shall represent the effect of one given strain on that vector, while the effect of their *successive* performance in a given order on any vector shall be equivalent to that of another given strain. It is curious to compare this with the physical meaning of the differential equation from which these forms are derived.

If $g$ be one of the roots of the symbolical cubic in $\chi$ (of which two will in this case generally be imaginary) and $\eta$ the corresponding unit vector, such that we have three conditions of the type

$$(\chi - g)\eta = 0,$$

we have

$$(g^2 - g\varphi + \psi)\eta = 0.$$

The vectors, which satisfy this and the two similar equations, are (all three) sides (real or imaginary) of the cone of the third order

$$\mathrm{S}.\rho\varphi\rho\psi\rho = 0.$$

One curious result, which is easily derived from the equations above, is that, if a solid experience a pure strain, the planes in which any three, originally rectangular, vectors are displaced intersect in one line.

## 4. On some Quaternion Integrals. By Professor Tait.

(*Abstract.*)

In my paper on "Green's and other allied theorems" (*Trans. R. S. E.* 1869–70), I showed that

$$\int \mathrm{P} d\rho = \iint ds\, \mathrm{V}.\mathrm{U}\nu\nabla\mathrm{P},$$

where P is any scalar function of $\rho$, and the single integral is extended round any closed curve, while the double integral extends over any surface bounded by the curve, $\nu$ being its normal vector.

Writing

$$\sigma = i\mathrm{P} + j\mathrm{Q} + k\mathrm{R}$$

this gives at once

$$\int \sigma d\rho = \iint ds\, (\mathrm{S}.\mathrm{U}\nu\nabla\sigma - \mathrm{V}.(\mathrm{V}.\mathrm{U}\nu\nabla)\sigma),$$

of which the scalar and vector parts respectively were, in the paper referred to, shown to be equal.

From these equations many very singular results may be derived, some of which form the first part of the subject of the present communication.

Let $\sigma$ be a vector which, having continuously varying values over the surface in question, becomes $\mathrm{U}d\rho$ at its edge. Then

$$-\int \mathrm{T}d\rho = \iint ds\, \mathrm{S}\,.\,\mathrm{U}\nu\nabla\sigma,$$

there being no vector part on the left-hand side. This gives the *length* of any closed curve in terms of an integral taken over any surface bounded by it.

We have evidently

$$\mathrm{T}\rho\, d\mathrm{T}\rho = -\mathrm{S}\rho d\rho,$$

whence

$$\int \mathrm{P}d\mathrm{T}\rho = -\int \mathrm{PS}\,.\,\mathrm{U}\rho d\rho = -\iint ds \mathrm{S}\,.\,\mathrm{U}\nu\nabla(\mathrm{PU}\rho).$$

Hence

$$\int \sigma d\mathrm{T}\rho = -\iint ds\, \mathrm{S}\,.\,(\mathrm{U}\rho\mathrm{U}\nu\nabla)\,\sigma,$$

for

$$\nabla\mathrm{U}\rho = -\frac{2}{\mathrm{T}\rho}.$$

Now if $\mathrm{T}\rho$ be constant over the boundary, *i.e.*, if the bounding curve lie on a sphere whose centre is the origin, we have for any surface bounded by it

$$\iint ds\, \mathrm{S}\,.\,(\mathrm{U}\rho\mathrm{U}\nu\nabla)\sigma = 0,$$

*whatever* be the value of the vector $\sigma$.

Again, if $\sigma$ be a function of $\mathrm{T}\rho$ only, we have

$$\int \sigma\, d\mathrm{T}\rho = 0$$

for all closed curves. Hence, whatever be the vector-function $\varphi$, and whatever the surface and its bounding curve, we have always

$$\iint ds\, \mathrm{S}\,.\,(\mathrm{U}\rho\mathrm{U}\nu\nabla)\,\varphi(\mathrm{T}\rho) = 0.$$

Another very simple but fundamental theorem, in addition to those given in the paper above referred to, may be stated as follows:—Let P be the potential of masses external to a space $\Sigma$. Then throughout $\Sigma$ we have

$$\nabla^2\,\mathrm{P} = 0,$$

so that

$$\iiint \nabla^2\mathrm{P}d\varsigma = \iint \mathrm{SU}\nu\nabla\mathrm{P}\,.\,ds = 0.$$

The double integral is therefore of constant value for all non-closed surfaces having, as common boundary, a closed curve and not extending into space occupied by any part of the masses. To find its value in terms of a single integral taken round this curve, let

$$\nabla^2\tau = \nabla\mathrm{P}.$$

As P is known, the constituents of $\tau$ are perfectly definite, being the potentials of given distributions of matter. And the substitution of functions of $\tau$ for those of P gives us, by means of the general formula at the beginning of this paper,

$$\iint \mathrm{SU}\nu\nabla\mathrm{P}\,.\,ds = \mathrm{S}\int \mathrm{V}\,(d\rho\nabla)\,\tau,$$

with the condition

$$\mathrm{S}\nabla\tau = 0.$$

Again, we have obviously, as $\nabla^2\sigma$ is necessarily a vector,

$$\iint \mathrm{S}\,.\,\mathrm{U}\nu\nabla^2\sigma\,ds = \int \mathrm{S}\,.\,\nabla\sigma\,d\rho.$$

Now, let $\sigma = i\mathrm{P}$, then

$$\iint \mathrm{S}\,.\,i\mathrm{U}\nu\,.\,\nabla^2\mathrm{P}ds = \int \mathrm{S}(id\rho\nabla)\mathrm{P}\,.$$

From this

$$\iint \mathrm{U}\nu\nabla^2\mathrm{P}ds = \int \mathrm{V}(d\rho\nabla)\mathrm{P}\,.$$

A particular case of this, for a curve in the plane of $xy$ and the surface bounded by it, is

$$\iint\left(\frac{d^2\mathrm{P}}{dx^2} + \frac{d^2\mathrm{P}}{dy^2}\right)dxdy = \int\left(\frac{d\mathrm{P}}{dx}\,dy - \frac{d\mathrm{P}}{dy}\,dx\right)$$

which has obvious applications to fluid motion parallel to a plane.

But, generally, we have also

$$\iint \mathrm{U}\nu\nabla^2\sigma\,ds = \int \mathrm{V}(d\rho\nabla)\,.\,\sigma.$$

If we take the vector of this, or if we subtract from each side the corresponding member of our first equation above, we have

$$\iint \mathrm{V}\,.\,\mathrm{U}\nu\nabla^2\sigma\,ds = \int \mathrm{V}\,.\,(\mathrm{V}\,.\,d\rho\nabla)\sigma.$$

These results appear to be of considerable importance for physical applications, and are particularly interesting, because they involve the operator (indicated merely in my former paper).

$$\mathrm{V}(d\rho\nabla)\,.$$

The paper contains several applications and modifications of these theorems.

## 5. Note on an Ice Calorimeter. By Dr A. Crum Brown.

The principal upon which this calorimeter is founded is, that a contraction of a definite amount takes place on the conversion of ice at 0° C. into water at 0° C., and that a definite amount of heat is required for this conversion. Early in the year 1866 I sent a description and drawing of the instrument to Messrs Kemp & Co., instrument-makers here, with an order to have it constructed. Some mechanical difficulties occurred which prevented its completion at the time. I should not have laid before the Society an account of an unfinished instrument were it not that Professor Bunsen has recently published* an account of a calorimeter founded on the same principle. The two instruments are quite different in detail, and are primarily intended for different purposes—Professor Bunsen's for the estimation of specific heat, and mine for the estimation of the heat produced during chemical changes.

While, of course, fully acknowledging Professor Bunsen's priority, I lay this note before the Society for the purpose of preserving to myself the right to use my own instrument.

It consists of a cylindrical vessel A, the *calorimeter*, furnished with a tightly-fighting flanged lid of a conical form. This is fixed to the corresponding flange on the calorimeter by means of binding screws, and has a small hole at its apex, which can be completely closed by means of a screw D.

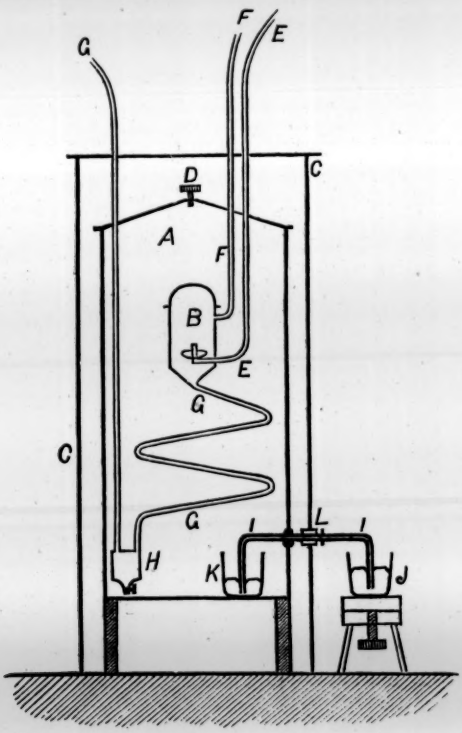
Within the calorimeter is contained a smaller cylindrical vessel B, the *laboratory*, closed above by means of a flanged lid. Into it open two tubes, EE and FF. One of these, EE, carries a small plate, upon which apparatus may be placed. From the bottom of the laboratory a tube, GGG, passes, spirally bent in its descending part, and having a reservoir with a stop-cock between its descending and ascending parts. All these tubes pass tightly through the lid of the calorimeter.

The whole apparatus is enclosed in an outer cylinder CC.

The doubly bent glass tube II connects the vessel K within the calorimeter, and the vessel J without. It passes through a tight stuffing-box in the wall of the calorimeter, and through a perforated

* Poggendorff's Annalen, vol. cxli. p. 1. 1870.

cork in the wall of the vessel C; it is formed of two pieces, which can be disconnected at L, so as to allow of the removal of the calorimeter from the jacket. The calorimeter A is to be filled with ice and water, both free from air; the tubes EE and FF supply the gases (previously cooled to 0° C.) necessary for the chemical




operation taking place in the laboratory B; while GG removes the products of combustion, those which condense collecting in H. The vessels J and K contain mercury, and it is obvious that the quantity of mercury transferred from the one to the other is the measure of the thermal change accompanying the chemical action. The space between the calorimeter and the jacket C is filled with melting ice.

The following Gentleman was elected a Fellow of the Society:—

Rev. Thomas Lindsay, M.A.